SOIL SURVEY

Merced Area California

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
CALIFORNIA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of the Merced Area will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; aid ranchers in managing their grazing lands; and add to our knowledge of soils.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the Area, on which numbered rectangles have been drawn to show what part of the Area is represented on each sheet of the large map. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, that an area located on the map has a symbol HwA: The legend for the detailed map shows that this symbol identifies Honcut silty clay loam, 0 to 1 percent slopes. This soil and the other soils in the area surveyed are all described in the section "Soils of the Merced Area."

Finding information

Farmers and those who work with farmers can learn about the soils in the section "Soils of the Merced Area" and then look at the section "Use and Management." In this way they first identify the soils on a given farm and then learn how these soils can be managed and what yields can be expected. The soils are grouped by capability units; that is, groups of soils that need similar management and respond in about the same way. For example, in the section "Soils of the Merced Area," Honcut silty clay loam, 0 to 1 percent slopes, is shown to be in capability unit I–1. The management this soil needs will be found under the heading "Capability unit I–1," in the section "Capability Groups of Soils." This soil is shown to have a Storie index rating of 90. The Storie index is explained in the section "Relative Suitability for Agriculture." It provides a means of comparing one soil of the Area with another.

Soil scientists will find information about how the soils were formed and how they were classified in the section "Formation and Classification of Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers to the Area can get a general idea of the geography and agriculture by reading the sections "General Nature of the Merced Area" and "Agriculture."

The Guide to Mapping Units and Capability Units, which is at the back of the report, shows the reader where in the report to find information about each particular soil.

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Fieldwork for this survey was completed in 1950. Unless otherwise indicated, all statements in the report refer to conditions in the Area at that time. This publication is a cooperative contribution from the Soil Conservation Service and the California Agricultural Experiment Station.

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Issued July 1962

Reissued March 1991

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE CALIFORNIA AGRICULTURAL EXPERIMENT STATION

THE MERCED AREA occupies all of Merced County lying northeast of the San Joaquin River. It is near the center of the State (fig. 1). The area is bounded on the southwest by the San Joaquin River, on the southeast by Madera County, on the northeast by Mariposa County, and on the northwest by Stanislaus County. It contains about 1,031 square miles, or 659,840 acres.

The county seat, Merced, is the principal town in the Area. It is called "The Gateway to Yosemite" because Yosemite National Park is 81 highway miles to the northeast.

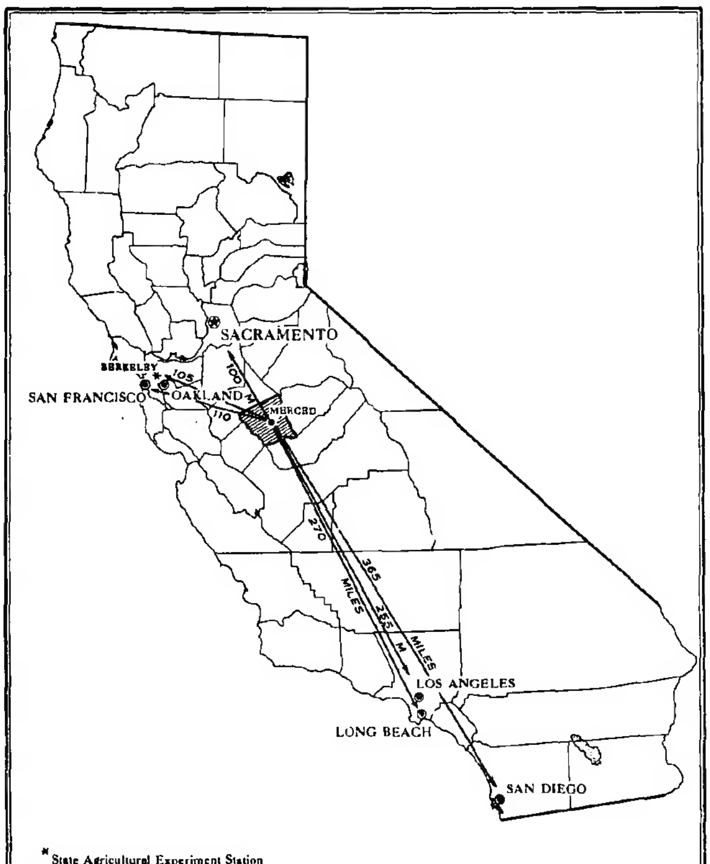


Figure 1.—**Location of the Merced Area in California.**

The Merced Area is in the north-central part of the San Joaquin Valley, on the eastern side. The San Joaquin Valley is the southern half of the Great Valley of California. The physiography of the Area is described in the section "Soil Associations" and mapped in figure 2. The soil materials in the Merced Area consist mainly of sediments eroded from the mountains of the Sierra Nevada to the east and brought into the Area by the Merced, Chowchilla, and San Joaquin Rivers.

The Sierra Nevada and its relationship to the Great Valley has been described as follows (*21*): [1]

"In height above the surrounding country it is a remarkable range, standing 14,000 feet above the Great Valley and about 11,000 feet above Owens Valley to the east. . . . The range may be compared to a westward tilted plateau, with a steep scarp along its east flank. Structurally it is a great block of the earth's crust, tilted westward toward, and dipping under, the alluvium of the San Joaquin and Sacramento Valleys. Its broad western flank is scored by deep canyons through which run a series of great rivers. . . .

"The plain lying between the Coast Ranges and the Sierra Nevada is drained by the San Joaquin and Sacramento Rivers. It is approximately 450 miles long. . . . Its width has considerable range, but is on the average approximately 40 miles. The central portion of the plain is covered by alluvium; its borders in many places have outcrops of Tertiary or Cretaceous rocks, or both."

The Ione, Valley Springs, and Mehrten formations are Tertiary rocks exposed in the eastern part of the Merced Area. They rest directly upon metamorphic and igneous rocks of the bedrock complex.

Soil Associations

Soil associations are geographic areas in which certain soils regularly occur together in a repeating pattern. Several soil associations may be present on any particular kind of physiography or land form.

About 85 percent of the 1,031 square miles in the Merced Area is covered with alluvial material washed from the Sierra Nevada. The alluvium varies considerably in mineral composition and in manner of deposition. Some is fresh and unweathered, and some has been developing into soil for thousands of years. The texture ranges from fine clay and silt in the lower basin area to gravel and cobblestones on the old, high terraces north of Yosemite Lake. The reaction ranges from strongly acid on the oldest and highest terraces to strongly alkaline in the

[1] Italic numbers in parentheses refer to Literature Cited, p. 126.

saline-alkali basin. In agricultural value the soils range from high to very low. The best are fertile and productive; the poorest are strongly acid, cobbly, leached, and infertile or are so high in salts and alkali as to be unfit for cultivation.

Many of the differences in parent material, drainage, texture, and productivity can be understood more easily by grouping the soils according to the land form on which they occur. The most important land forms or physiographic sections in the Merced Area are (1) the recent alluvial fans and flood plains, (2) the young alluvial fans and flood plains, (3) the poorly drained saline-alkali basin, (4) the low terraces, (5) the high terraces, and (6) the uplands. A few miscellaneous land types also are present.

Figure 2 shows the location of these physiographic sections in the Area. Figure 3 is a diagrammatic cross section of the Area, showing the soils that are dominant in each of the physiographic sections and some characteristics of each soil.

These well-defined physiographic sections can be subdivided on the basis of drainage and characteristics of parent material. This results in a clear-cut pattern of soil associations. These soil associations are shown on the colored map at the back of the report.

Soils of the Alluvial Fans and Flood Plains

These soils cover 341 square miles. Of this, 92 square miles are covered by recently deposited alluvial material. The other 249 square miles are covered by material that is geologically young but somewhat older than the most recent deposits.

The most recent alluvial fans and flood plains are mainly along the Merced River bottom lands, which extend across the northern part of the Area in a narrow valley 30 to 50 feet below the surrounding countryside. This valley is a narrow gorge in the foothills. Near Snelling it widens to a breadth of 3 miles, and farther downstream it narrows abruptly to a width of a few hundred feet. A small alluvial fan lies just west of Stevinson, near the San Joaquin River. The Merced River flood plain was formerly subject to frequent floods, but it is now partly protected by Exchequer Dam in Mariposa County. Alfalfa is the principal crop grown on this flood plain.

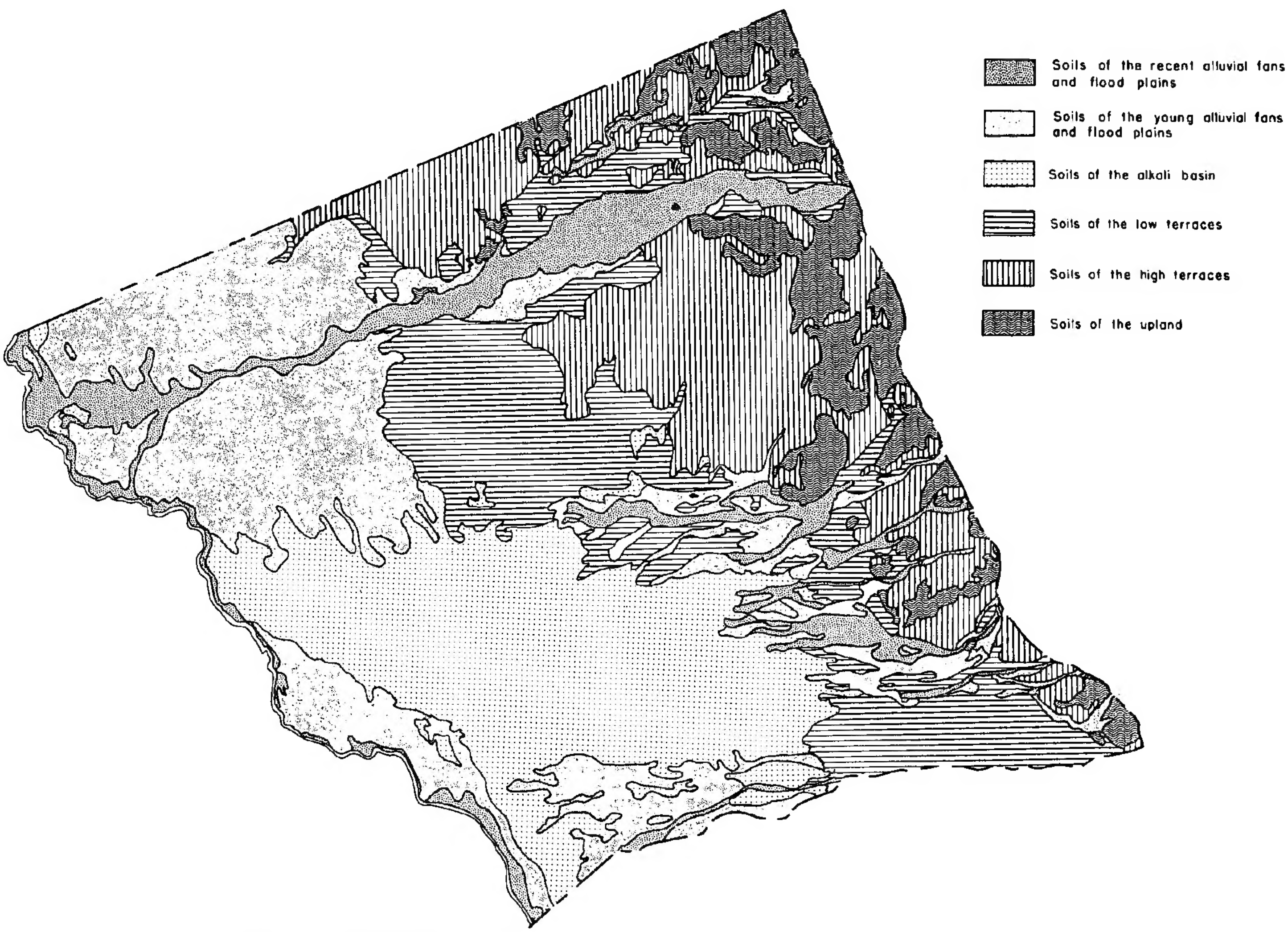


Figure 2.—Distribution of the soils in the Merced Area by physiographic sections.

A narrow fringe of recently deposited alluvium forms a low natural levee along the San Joaquin River. Near Merced and southeastward to near Le Grand, many small alluvial fans, flood plains, and stream ridges have been formed of material deposited by Burns Creek, Bear Creek, Owens Creek, Mariposa Creek, and several other minor streams. The agriculture in this area is highly specialized and intensive, and many kinds of irrigated crops are grown.

The broad, sandy alluvial fan that has been laid down by the Merced River west of Livingston and Ballico is made up of somewhat older alluvium. Most of the soils on this fan are sandy. Wind erosion is active. Gently undulating remnants of dunes characterize the topography. Intensive irrigated agriculture has developed in this area. The main crops are alfalfa, grapes, peaches, and almonds.

Other small alluvial fans that now receive little or no fresh alluvium occur along the minor streams southeast of Merced.

A small part of the alluvial fan of the Chowchilla River is along the southern edge of the Area. Near El Nido, this fan consists mainly of a complex system of braided channels and fingers of alluvium over the older saline-alkali soils of the basin. The complex pattern of soils that results makes the agricultural development somewhat spotty. Toward the east, the Chowchilla River is entrenched in a channel about one-fourth of a mile wide. A few low terraces in this channel are farmed to grain.

A narrow band of flood plain lies along the eastern side of the San Joaquin River. This area was formerly flooded every year early in summer when the snow melted in the Sierra Nevada. The floodwaters overflowed large areas of the San Joaquin Valley and moved off slowly, leaving a swampy area, which was used for summer grazing. The construction of Friant Dam on the San Joaquin River has partly controlled these floods.

The soil associations on the alluvial fans and flood plains are the Hanford-Grangeville association, the Pachappa-Grangeville association, the Delhi-Atwater association, the Hilmar-Delhi-Dello association, the Wyman-Yokohl-Marguerite association, and the Merced-Temple-Columbia association.

1A. Hanford-Grangeville association

These soils lie on the Merced River flood plain, between Merced Falls and the San Joaquin River. The parent material was recent alluvium derived from granitic rocks. The soils are medium textured to moderately coarse textured, deep, and uniform throughout. The Hanford soils are well drained, and the Grangeville soils are imperfectly drained, mottled, and slightly calcareous.

The soils in this association are used mostly for alfalfa, corn for silage, and such truck crops as tomatoes. They are limited principally by occasional flooding and by a fluctuating high water table in the Grangeville soils.

1B. Pachappa-Grangeville association

The Chowchilla alluvial fan on the southern edge of the Area consists mainly of Pachappa and Grangeville soils, along with small areas of Borden and Hanford and narrow streaks of Tujunga soils. The association has a complex pattern of sandy streaks and saline-alkali spots interspersed with a few areas of better quality Pachappa and Hanford soils.

The Pachappa soils have slightly more clay in their subsoil than in their surface soil, and in many places they contain slight concentrations of salts and alkali. The Borden soils are similar to the Pachappa soils, but they have more clay in the subsoil. The Grangeville soils are imperfectly drained, mottled, and slightly calcareous.

Cotton, alfalfa, and field crops are most commonly grown. Yields in many of the fields are spotty and irregular.

1C. Delhi-Atwater association

This association lies north and south of the Merced River, near the towns of Delhi and Atwater. It consists of well-drained, wind-modified, sandy soils. In scattered depressions the water table is high.

The Delhi soils consist of sand and loamy sand that vary but little with depth. In places they are underlain by lenses of silty material. The Atwater soils also consist of sand and loamy sand, but they have a slight accumulation of clay in their subsoil. At the eastern edge of each area, the Atwater soils overlie older hardpan soils.

The chief crops in this association are alfalfa, sweetpotatoes, almonds, peaches, and grapes.

1D. Hilmar-Delhi-Dello association

This association lies to the west of the Delhi-Atwater association. Its sandy soils are similar to those in the Delhi-Atwater association, but they are affected by a high water table and by slight concentrations of salts and alkali. The Delhi soils are in the better drained parts of the association, and the Hilmar and Dello soils in the lower lying parts or depressions. The Hilmar soils are underlain by silty lenses, some of which are cemented with lime. The Dello soils are alkaline and somewhat mottled.

This association is used mainly for irrigated alfalfa, grapes, sweetpotatoes, and pasture. Dairy farming is common.

1E. Wyman-Yokohl-Marguerite association

This association is located near Merced, Planada, and Le Grand, and in the northern part of the Area along Dry Creek. It consists of well-drained, medium textured and moderately fine textured soils that developed from alluvium derived from slate, schist, and metamorphosed sandstone. The soils show various degrees of development. The Honcut and Yolo soils along the streams are uniform throughout their profile. Between the stream valleys, the Wyman soils have slightly more clay in the subsoil than in the surface soil, and the Ryer soils have a moderate accumulation of clay in the subsoil. Several areas of Yokohl soils have an indurated iron-silica hardpan.

These soils are used intensively for peaches, almonds, figs, grapes, alfalfa, and field crops.

1F. Merced-Temple-Columbia association

This association is located on the flood plain of the San Joaquin River. The parent material of the soils was alluvium from mixed igneous and sedimentary rocks. The imperfectly drained Columbia soils lie close to the river.

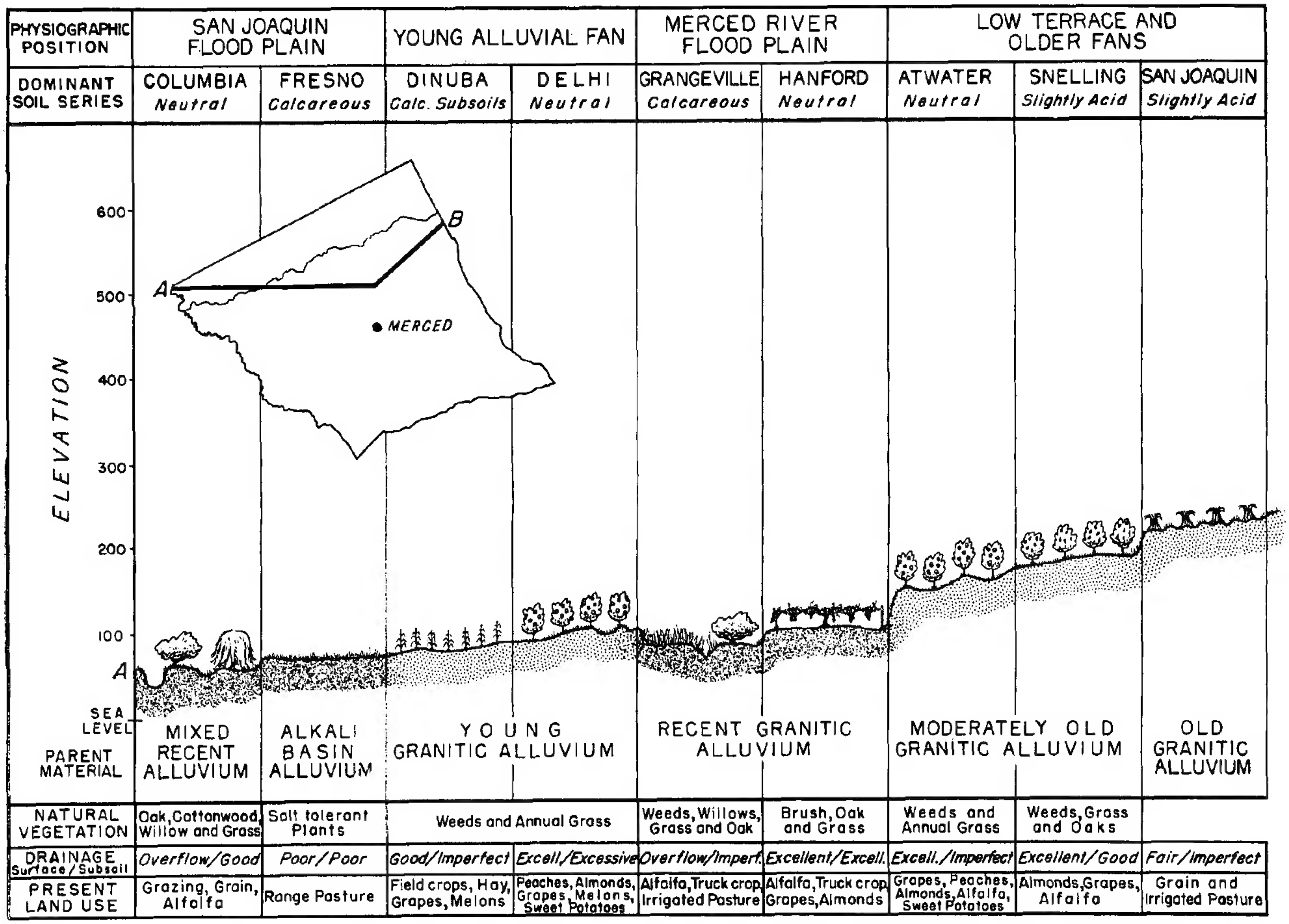


Figure 3.—**Diagrammatic cross section of the Merced Area, showing the topography and elevations of the physiographic sections;**

They have a uniform profile that consists of mottled, moderately coarse textured alluvium. The Merced and Temple soils are farther away from the river, where deposition is relatively slow. They are dark-colored, medium-textured to fine-textured soils that have strongly calcareous subsoils.

The soils in this association are used for range, sugar-beets, and cotton.

Soils of the Poorly Drained Saline-Alkali Basin

The southern part of the Merced Area is occupied by a broad, nearly level plain that has some low mound microrelief. This physiographic section is the second most extensive in the Area. It covers 227 square miles. Strong accumulations of salts and alkali and poor drainage are characteristic of the soils in the basin.

Agriculture in this part of the Area is limited and consists mainly of raising beef cattle.

The soil associations in the poorly drained saline-alkali basin are the Lewis-Landlow-Burchell association, the Fresno-Traver association, the Rossi-Waukena association, and the Fresno-Pozo association.

2A. Lewis-Landlow-Burchell association

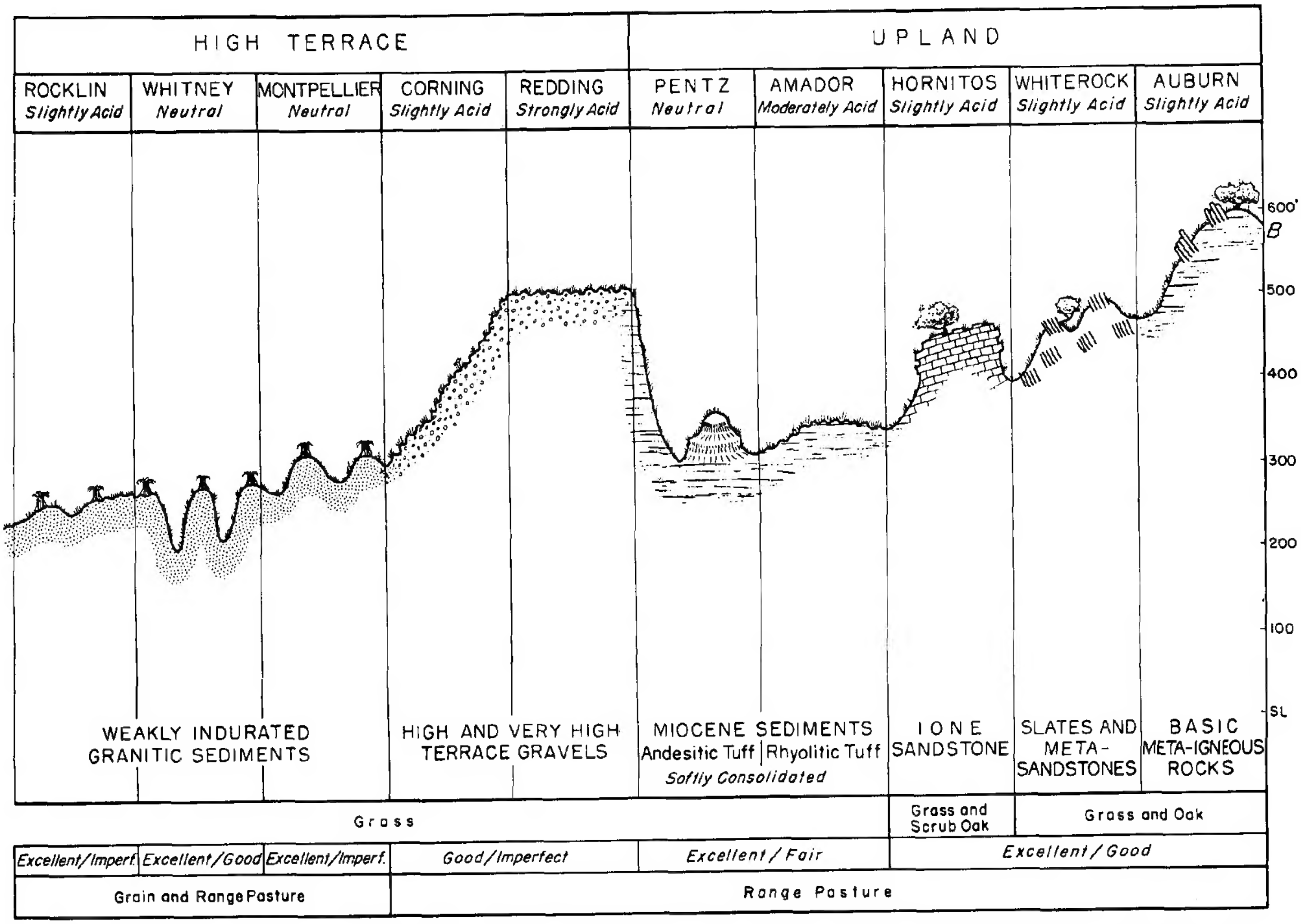
This association occupies an area south of Merced that extends west from the Southern Pacific Railroad to within 5 miles of the San Joaquin River. The soils developed from medium textured to moderately fine textured alluvium that was derived partly from granite and partly from metamorphosed sedimentary rocks. Surface runoff is very slow. The water table is generally high.

The Landlow and Burchell soils are dark colored. They have a calcareous subsoil, and in some areas the surface soil is affected by salts and alkali. The Lewis soils are more strongly affected by salts and alkali. They have a fine-textured subsoil that is underlain by a cemented lime-silica hardpan.

These soils are used mainly for field crops, irrigated pasture, and rice. The areas that are more strongly affected by salts and alkali are used only for range.

2B. Fresno-Traver association

This association occurs south of the Lewis-Landlow-Burchell association and north of the Chowchilla alluvial fan. The parent material of the soils was alluvium derived



the soils dominant in each; the parent material, reaction, and drainage of each soil; and the natural vegetation and present use.

from granitic rocks. Surface runoff is very slow. Nearly the entire area is affected by salts and alkali.

The dominant soils in this association are the Fresno soils, which are shallow to moderately deep over a strongly cemented lime-silica hardpan. The Traver soils occupy small stringers and fans of more recent alluvium. The Traver soils have slightly more clay in their subsoil than in their surface soil, but they have no hardpan.

The Fresno soils are used mainly for range. The Traver soils are used for field crops, cotton, and irrigated pasture.

2C. Rossi-Waukena association

This association lies west of the Lewis-Landlow-Burchell association. The soils developed from mixed but predominantly granitic alluvium. The water table is high. Most of the acreage is affected by moderate to strong concentrations of salts and alkali.

The Waukena soils are light colored and medium textured. They have a claypan in the subsoil. The Rossi soils are dark colored and moderately fine textured to fine textured. Their subsoil has a subangular blocky structure.

These soils are used mainly for range. Some areas are in rice and irrigated pasture.

2D. Fresno-Pozo association

This association is located in the extreme southwestern corner of the Merced Area, along the Madera County line, just east of the San Joaquin River. Surface drainage is very slow. Most of the acreage is affected by salts and alkali.

The Fresno soils are dominant in this association. They are shallow to moderately deep over a strongly cemented lime-silica hardpan. The Pozo soils are similar to the Fresno soils, but they have a dark-colored surface soil and they are less affected by alkali.

These soils are used mainly for range. Cotton and irrigated pasture are grown to some extent on the Pozo soils.

Soils of the Low Terraces

Soils of low terraces cover 186.5 square miles in the Merced Area. The largest area is on benches several miles wide that lie on both edges of the Merced River flood plain and widen into an alluvial fan surrounding Atwater and Winton. The soils on the level benches are sandy loam, and the soils on the gently undulating to undulating alluvial fan are loamy sand and are subject to some

wind erosion and deposition. These areas are used for intensive irrigated agriculture. Fruits, nuts, grapes, alfalfa, and sweetpotatoes are grown.

In other parts of the Area are slightly older alluvial fans and terrace remnants that have undulating topography and mound microrelief. These are located along Dry Creek north of the Merced River; north of Merced; on a large alluvial fan north of the Chowchilla River and east of the Southern Pacific Railroad; and on small terraces along Burns, Bear, Mariposa, Owens, Deadman, and Dutchman Creeks. The soils in these areas are medium textured. They are characterized by a strongly cemented or indurated hardpan subsoil. They are used mainly for range and for dryfarmed grain.

The soil associations on the low terraces and alluvial fans are the San Joaquin-Madera association, the Snelling-Greenfield association, and the Porterville-Seville association.

3A. San Joaquin-Madera association

There are three areas of this association. One is north of the Merced River and a short distance northeast of Delhi, another north of Merced, and the third in the southeastern part of the Area just north of the Chowchilla River. The topography is gently undulating and has a hogwallow microrelief. The parent material of the soils was old alluvium derived from granite.

The San Joaquin soils are reddish brown and have a slightly acid to medium acid reaction. The Madera soils are brown and have a slightly acid to mildly alkaline reaction, especially in the subsoil. Both soils have an indurated iron-silica hardpan at a depth of 18 to 36 inches.

These soils are used for dryfarmed grain or irrigated pasture.

3B. Snelling-Greenfield association

This association occurs on the well-drained, somewhat older alluvial terraces of the Merced River near Snelling. The topography is generally smooth and gently sloping. The parent material was moderately coarse textured alluvium derived from granite.

These soils have slightly to moderately larger amounts of clay in the subsoil than in the surface soil. The Snelling soils have a light-colored sandy loam surface soil over a brown sandy clay loam subsoil. The Greenfield soils are similar, except that their subsoil contains less clay. In some places they are underlain at a depth of 3 to 4 feet by an unrelated iron-silica hardpan substratum.

These soils are used for grapes, alfalfa, almonds, and irrigated pasture.

3C. Porterville-Seville association

Two small areas of this association are located near Planada. The soils consist of calcareous clay that developed on terraces from alluvium derived from basic igneous rocks. The surface soil is granular when dry, but it becomes very sticky and plastic when wet. The Porterville soils are dark reddish brown, and their subsoil contains lime. The Seville soils are grayer, are calcareous throughout, and have a lime-cemented caliche hardpan in the subsoil.

These soils are used for figs, irrigated pasture, dryfarmed grain, and range.

Soils of the High Terraces

These soils cover 188.5 square miles. Some are fine sandy loam and some are gravelly loam. There are three main areas: a sandy terrace along the northwestern boundary of the Area, a gravelly terrace south of the Merced River and east of Winton, and a somewhat lower gravelly terrace in the northern part of the Area and near Yosemite Lake.

The sandy terrace extends from the foothills north of the Merced River westward along the Stanislaus County line to the Sante Fe railroad. Most of it is dissected into low, rounded hills, but a few level remnants remain. The elevation ranges from 150 feet at the Santa Fe railroad to 350 feet north of Snelling. The alluvium from which this terrace formed was derived from granite. There are deposits of the same kind of material between Merced Falls and Planada and others north of Merced.

The higher of the two gravelly terraces extends from a point about 4 miles east of Winton northeastward almost to the foothills. This terrace is clearly very old. At its eastern end it has an elevation of nearly 800 feet, but the elevation declines toward the west-southwest at a rate of about 60 feet per mile. The undulating landscape is dominated by a mound microrelief. The soils are gravelly or cobbly loam, very strongly weathered and infertile. There are no trees, and the grass is generally of poor quality.

The lower gravelly terrace is near Yosemite Lake and northeast of Snelling. At its eastern end it is higher than the sandy terrace, but it slopes toward the west; its western end, north of Merced, has about the same elevation as the sandy terrace. Mound microrelief is characteristic of this area also. There are almost no trees, but there is more grass than on the higher gravelly terrace.

4A. Whitney-Rocklin-Montpellier association

This association occupies two large areas along the Stanislaus County line and two smaller areas southwest of Snelling. It consists of soils that formed from moderately coarse material overlying beds of silt and fine sand.

The Whitney soils, the most extensive in this association, are on the dissected, rolling and hilly parts of the sandy terrace. They are medium textured to moderately coarse textured and are underlain at various depths by finer textured sediments. The Rocklin soils are undulating. They have a slight accumulation of clay in the subsoil and are underlain by a thin, cemented iron-silica hardpan. The Montpellier soils are moderately coarse textured and have a sandy clay loam subsoil.

The soils in this association are used almost entirely for dryfarmed grain and range.

4B. Redding-Pentz-Peters association

One large area of this association is northeast of Merced, and several smaller areas lie along the eastern boundary of the Area. Some of the soils formed from old gravelly alluvium and some from the underlying andesitic tuff, from which the covering of gravelly alluvium had been removed by erosion.

The Redding and Keyes soils, which formed from the gravelly materials, have both a claypan and an indurated iron-silica hardpan. The Pentz and Peters soils, which

developed where andesitic tuff was exposed, are shallow and medium textured. Raynor clay is also included in this association. It developed from material weathered from andesitic tuff. It is deeper than the other soils and has a blocky structure.

Soils of the Uplands

In the northeastern corner of the Area and along most of the eastern boundary, a narrow fringe of foothills, less than 1,000 feet in height, extends into the Area from Mariposa County. Some of the hills are rounded and have rows of rock outcrops in places; they formed from slate and metamorphosed igneous rocks. Buttes—for example, the Planicosta Buttes south of Merced Falls—have formed from the same kind of slate and metamorphosed igneous rocks capped with remnants of Ione (formerly Tejon) sandstone (*1*). Mound microrelief, locally called hogwallows, exists in the more nearly level areas (*24*).

Just to the west of these true foothills is a large area where softly consolidated tuffaceous sediments are exposed. These sediments weather into conical hills around which bands of harder strata outcrop in concentric rings. A typical example is Haystack Mountain, 10 miles northeast of Merced. Mound microrelief has developed in some parts of this area.

The soils of the uplands cover 88 square miles. The soil associations are the Amador-Hornitos association and the Auburn-Exchequer-Daulton-Whiterock association.

5A. Amador-Hornitos association

This association lies in a narrow band along the eastern boundary of the Merced Area. The soils are shallow to very shallow. They formed from material weathered from siliceous rhyolitic tuff and sandstone. Fertility is low.

These soils are used only for range. Production of forage is meager, and the carrying capacity is low.

5B. Auburn-Exchequer-Daulton-Whiterock association

This association consists of shallow to moderately deep soils formed from metamorphic, sedimentary, and basic igneous rocks. Most of the topography is rolling and hilly.

The Auburn soils were derived from basic igneous rocks and schist. They have slightly more clay in the subsoil than in the surface soil. The Exchequer soils were also derived from basic igneous rocks and schist, but their profile is shallow and uniform over bedrock. Both the Daulton and Whiterock soils formed on slate and metamorphosed sandstone. The Daulton soils are gray to dark gray, and the Whiterock soils are light brown to light yellowish brown. Rock outcrops are common in all of the soils in this association.

These soils are used almost entirely for range.

Miscellaneous Land Types

The miscellaneous land types scattered over the Area are not true soils. Most areas are too small to be mapped in a separate soil association. Only Tailings covers large enough areas to be mapped separately.

The miscellaneous land types are generally of no agricultural value.

T. Tailings

This association is on the bottom lands of the Merced River near Snelling. It consists of gravel and cobblestones that were piled up as a result of dredging for gold.

These areas have no value for agriculture.

General Nature of the Merced Area

Climate

The climate of the Merced Area is distinctly semiarid and of the Mediterranean type. It is fairly typical of the climate in the middle San Joaquin Valley. Most of the oceanic and continental influences are excluded from the Merced Area, as from a greater part of the San Joaquin Valley, by the high walls of mountains that enclose the Valley on the east, south, and west. Summers are long, dry, and hot—during some periods, very hot. Winters are cool and have varying periods of gentle rain, ground fog, and clear frosty weather (*29*).

Midday temperatures on the cloudless, hot, summer days range from 100° to 110° F., and temperatures as high as 117° F. have been recorded. July and August are the two hottest months, but the clear, dry air allows rapid radiation, and the difference between day and night temperatures frequently amounts to 40° F. or more. Thus, even with these extremely hot days, the average temperature for these two months is only about 79° F. The relative humidity is low. Table 1 gives the relative humidity in Fresno, Calif., at several hours of the day. Fresno is the nearest station for which this information is available.

During the long frost-free growing season, the rainfall is not enough for any crops except grain or winter and spring grasses. With irrigation, however, the long growing period, the high temperatures, and the very high percentage of sunshine make an ideal climate for growing fruits, nuts, and grapes, as well as cotton, alfalfa, milo, rice, pasture grasses, and sweetpotatoes.

TABLE 1.—*Hours of sunshine as a percentage of hours of sunshine possible, and average humidity at various times of the day in Fresno, Calif.*

Month	Hours of sunshine	Average relative humidity		
		5 a.m.	Noon	5 p.m.
Length of record in years	53	43	18	43
	Percent			
January	44	90	68	68
February	63	87	59	56
March	70	85	51	49
April	82	79	41	36
May	87	71	33	27
June	94	58	27	19
July	96	50	24	15
August	96	54	26	16
September	91	61	31	23
October	86	72	38	34
November	72	80	49	50
December	49	89	68	68
Annual	78	73	43	38

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TABLE 2.—*Temperature and precipitation at three stations in the Merced Area, Calif.*

Month	Merced Fire Station (Elevation, 169 feet)						Le Grand (Elevation, 255 feet)						Los Banos (Elevation, 125 feet)					
	Temperature [1]			Precipitation [2]			Temperature [1]			Precipitation [2]			Temperature [1]			Precipitation [2]		
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1877)	Wettest year (1884)	Average	Absolute maximum	Absolute minimum	Average	Driest year (1908)	Wettest year (1922)	Average	Absolute maximum	Absolute minimum	Average	Driest year (1877)	Wettest year (1884)
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*°F.*	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*°F.*	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*
December	46.7	76	16	1.80	0.85	3.63	45.8	78	11	2.06	0.81	3.91	47.8	80	18	1.40	0.65	3.96
January	45.6	77	16	2.23	1.14	1.64	45.5	79	11	2.38	1.12	3.07	47.5	81	14	1.66	.96	1.42
February	49.4	84	21	1.87	.03	4.39	49.5	82	21	2.35	.40	4.12	50.7	79	21	1.34	.25	3.09
Winter	47.2	84	16	5.90	2.02	9.66	46.9	82	11	6.79	2.33	11.10	48.7	81	14	4.40	1.86	8.47
March	53.3	87	23	1.86	.53	5.38	52.8	86	24	2.20	.00	4.72	55.4	86	26	1.35	.16	2.95
April	59.5	96	28	1.00	(3)	5.60	58.2	98	28	.93	.45	.27	61.8	98	32	.66	(3)	1.80
May	66.4	109	32	.49	.52	.86	65.3	112	30	.46	.50	.97	67.5	106	36	.37	.04	1.03
Spring	59.7	109	23	3.35	1.05	11.84	58.8	112	24	3.59	.95	5.96	61.6	106	26	2.38	.20	5.78
June	74.1	111	40	.10	.00	1.73	73.3	115	32	.06	.00	.28	73.9	114	39	.06	.00	1.37
July	80.0	116	40	.01	.00	.00	79.8	117	36	.01	.00	.00	79.4	116	46	.01	.00	.00
August	78.0	114	41	.02	.00	.00	76.8	114	40	.00	.00	(3)	77.9	114	47	.01	.00	.00
Summer	77.4	116	40	.13	.00	1.73	76.6	117	32	.07	.00	.28	77.1	116	39	.08	.00	1.37
September	72.3	110	35	.17	.00	.00	71.5	111	33	.16	.25	.00	73.0	111	40	.12	.00	.00
October	63.3	102	28	.51	.06	.54	62.8	100	26	.70	.25	.63	64.5	102	28	.38	.00	1.01
November	53.5	90	21	1.20	1.17	.02	52.5	92	20	1.30	1.06	2.88	54.6	87	24	.90	.79	.05
Fall	63.0	110	21	1.88	1.23	.56	62.3	111	20	2.16	1.56	3.51	64.0	111	24	1.40	.79	1.06
Year	61.8	116	16	11.26	4.30	23.79	61.2	117	11	12.61	4.84	20.85	62.8	116	14	8.26	2.85	16.68

[1] Merced Fire Station: Average temperature based on an 82-year record, through 1955; highest and lowest temperatures on a 55-year record, through 1952. Le Grand: Average temperature based on a 55-year record, through 1955; highest temperature on a 51-year record and lowest temperature on a 49-year record, through 1952. Los Banos: Average temperature based on a 52-year record, through 1955; highest and lowest temperatures on a 38-year record, through 1952.

[2] Merced Fire Station: Average precipitation based on an 84-year record, through 1955; wettest and driest years based on an 82-year record, in the period 1873–1955. Le Grand: Average precipitation based on a 56-year record, through 1955; wettest and driest years based on a 55-year record, in the period 1900–1955. Los Banos: Average precipitation based on an 83-year record, through 1955; wettest and driest years based on an 82-year record, in the period 1874–1955.

[3] Trace.

Spring and fall are not distinct; they are mild transitions between summer and winter. The fall weather is mild and sunny and has little rainfall. It is satisfactory for drying figs, raisins, and other fruit.

During the winter, temperatures are very cool and humidity is high. The average temperature for the period of December through February is about 47.5° F. The average daily low temperature is 35° F., and the average midday temperature is 55° F. The damp, foggy, unpleasant days of winter are not continuous but are usually interspaced with mild, clear, sunny periods. Killing frosts are usually separated by frost-free periods.

The maximum, minimum, and average temperatures and precipitation for a period of 38 years or more, as shown in table 2, show the wide ranges that may occur. Rain falls mainly from November to April; January is usually the month of maximum rainfall. The average annual precipitation is 11.26 inches in Merced; more than 80 percent of this occurs between November and April. The precipitation decreases toward the southwest and increases toward the east. Los Banos, 24 miles away receives 8.26 inches annually. Le Grand receives 12.61 inches, and Merced Falls, on the easternmost edge of the Area, receives 14.92 inches. The annual rainfall in any given place is very erratic. A minimum of 2.85 inches and a maximum of 23.79 inches have been recorded.

The winter climate is cool and moist. Fog is common in the morning. Ordinarily it is dissipated by noon, but occasionally it will persist for several days at a time. Cloudbursts are rare, but they do occur in the foothills of the eastern part of the Area. Snow and hail are almost unknown. Rainfall is very rare from June through the first half of September. Light showers normally occur in May and the latter part of September. An average April day has a maximum temperature of 72.5° F. and a minimum of 44.8° F., although temperatures of 98° have been recorded in April and 112° in May.

The average length of the frost-free season at Merced is 257 days. At Le Grand, to the east, it is 239 days, and at Los Banos, to the southwest of Merced and at a slightly lower elevation, it is 323 days. The average dates of the first frost in the fall and the last frost in the spring vary

with locality. Frost has been recorded as early as November 17 and as late as March 23 in Le Grand, and on December 6 and January 17, respectively, at Los Banos. In Merced the earliest frost was recorded on October 27, and the latest on April 29. Except for an occasional hard freeze, the frost is not severe in partly sheltered locations. Many fruits, flowers, and shrubs not considered frost resistant are able to thrive. Young fruit crops may be damaged by frost in the spring, and orchard heating or smudging is practiced to protect peaches and almonds. Occasionally, an early frost freezes the johnsongrass and sudangrass and causes them to form prussic acid, which is poisonous to cattle.

Northwest winds prevail throughout the year, except for short periods, usually in September. The strongest winds occur in March. Rain is usually preceded by a shift in the direction of the wind, which at such times blows with moderate intensity from the southeast.

Vegetation

The native vegetation of the Merced Area has largely been replaced by introduced species or eliminated by cultivation and grazing.

"In the primitive condition, the vegetation of the San Joaquin Valley was what is generally known as 'grassland' formation although true grasses were not a conspicuous element in the flora. Open plains supported a vigorous growth of herbaceous plants, but trees and shrubs were almost entirely confined to the banks of streams. . . . Filaree (*Erodium cicutarium*) was mentioned by John C. Fremont as well as bush lupine (*Lupinus albifrons*) in his notes on his early explorations of the valley" (7).

The tree most commonly mentioned, the California white oak (*Quercus lobata*) (*10, 30*), is still common along the Merced River bottom land and the channels of the lesser streams. Other trees that commonly grow along the streams are Fremont cottonwood (*Populus fremontii*), Oregon ash (*Fraxinus oregona*), boxelder (*Acer negundo*), and several kinds of willows (*Salix* spp.). Some bushes and herbs are generally associated with the trees. *Bromus rigidus*, locally called ripgut grass, is an introduced species that grows abundantly under the trees. Most of the alluvial soils along the channels are cultivated, and the principal natural growth consists of weeds.

The natural cover of the basin area is made up largely of salt-tolerant plants. The soils generally contain soluble salts and alkali. The present natural vegetation of the basin area is of considerable importance to the beef and dairy industries. The principal grass is saltgrass (*Distichlis spicata*), which can grow on the saline-alkali soils that cover much of the basin. Saltgrass is fairly palatable and is pastured extensively. Other grasses that provide forage in the basin are wildrye (*Elymus* sp.), soft chess (*Bromus mollis*), alkali sacaton (*Sporobulus airoides*), spikeweed (*Centromadia pungens*), and foxtail (*Festuca megalura*). Also of considerable feed value are burclover (*Medicago hispida*) and alfileria (*Erodium cicutarium*). In poorly drained areas, rush (*Juncus* sp.), cattail (*Typha* sp.), and tule (*Scirpus acutus*) provide some forage. Areas subject to annual floods are often carpeted with lippia (*Lippia* sp.). Where the content of soluble salts is greater, there are such salt-loving plants as samphire (*Salicornia* sp.), alkaliweed (*Cressa* sp. and *Hemizonia pungens*), alkali mallow (*Sida hederacea*), alkali heath (*Frankenia grandifolia*), and various saltbushes.

On the well-drained uplands and high terraces, which are used mainly for grain and range, the most common forage plant is alfileria. On the less fertile and sandier soils, it is the dominant growth. Important range grasses are wild oats (*Avena barbata*, *A. fatua*), soft chess, foxtail, ryegrass (*Lolium* sp.), oatgrass (*Danthonia* sp.), and needlegrass (*Stipa* sp.). Burclover grows well on the Hopeton, Peters, and Raynor soils in years of favorable rainfall.

Weeds are a serious problem in some parts of the cultivated areas. Bermudagrass (*Cynodon dactylon*) is good forage in pastures, but it is considered a pest elsewhere, especially in alfalfa fields. Johnsongrass (*Sorghum halepense*) is a serious nuisance, particularly along the Merced River bottom land and on medium-textured soils. Whole crops of tomatoes and cotton have been lost because of rank growths of this weed. Other troublesome species are star-thistle (*Centaurea solstitialis*), puncturevine (*Tribulus terrestris*), sandbur (*Cenchrus pauciflorus*), tumbleweed (*Amaranthus graecizans*), morning-glory or bindweed (*Convolvulus* spp.), and camelthorn (*Alhagi camelorum*). These weeds can now be controlled in some places by selective weedkillers (*2, 3*). Tule and cattail cause difficulty in rice paddies and along irrigation and drainage ditches. The Merced County Agricultural Commissioner is in charge of the weed-control program in the Area. His office should be consulted for help with weed problems.

Wildlife

Although the San Joaquin Valley was reported as abounding in elk, deer, and antelope in 1827 (*22*), the wildlife of the Merced Area now consists almost entirely of rodents and birds. Deer enter the foothill fringe occasionally. Rodents are abundant. Ground squirrels are a range pest, and poison is used to control their depredations. Pocket gophers and rabbits, particularly jackrabbits, are common pests throughout the Area. Beavers build dams that interfere to a small extent with drainage and irrigation along the Merced River; they are protected, however, by game laws.

Ducks, geese, and other water-loving birds protected by game laws survive in considerable numbers in the basin area and ricefields and along the irrigation and drainage ditches. Quail, doves, and pheasants live in many areas. They are hunted extensively in season but are protected most of the year. Because most farms are posted against hunting, a number of private hunting clubs have been organized. Duck clubs are quite common in the basin area. Some of them own or lease land and maintain semipermanent ponds by the use of pumps and waste irrigation water.

Settlement and Population

The Merced Area, as well as the greater part of the San Joaquin Valley, was settled much later than the coast sections of California. Hunters and trappers who came in 1823 were the first white men in this region. Before 1848 there was no permanent settlement.

Permanent settlement began in 1849 and 1850, when gold was discovered in Mariposa County, east of this Area. No gold was found within the Merced Area at that time, but unsuccessful gold seekers very early began to settle along the bottom lands of the Merced River, along Mariposa Creek, and along the Millerton Road, which later became the eastern boundary of the county.

The population increased rapidly after the first settlement. In 1855, when Merced County was established, the population numbered 1,000. The first settlers came almost entirely from other parts of the United States, but later many immigrants came from Portugal, Italy, China, and countries of southern Europe. In the 1930's a large number of farmers migrated from Oklahoma, Arkansas, and Texas. The population of Merced County has increased 44 percent since the 1940 census and was 67,636 at the time of the 1950 census.

Snelling, on the Merced River, has a population of about 200. It was the first town in the county and was the county seat from 1855 until 1872. This community was set in beautiful, parklike surroundings on fertile alluvial soils, where large oak trees lined the watercourses. It overlooked broad fields of excellent irrigated alfalfa, corn, and pasture. Dredging for gold has rendered a large part of these once fertile alluvial soils a monotonous waste of various sized cobblestones, almost useless for agriculture.

Merced, the county seat since 1872, is the principal town and shopping center in the county. It is near the center of the Merced Area. Its population of 15,278, according to the 1950 census, shows a 50 percent increase since 1940 and a 116 percent increase since 1930. Merced is largely an agricultural center. There are only a few small factories and commercial enterprises that are not directly or indirectly connected with agriculture. Merced is served by two transcontinental railroads and two major bus lines. It is located on U.S. Highway No. 99, the main route between Los Angeles, Sacramento, and northern coastal cities, and also on State Highway No. 140, the principal route leading to Yosemite National Park.

The town of Merced Falls, where the Merced River emerges from its gorge in the foothills, has been abandoned and now has less than half a dozen houses. At one time it was of considerable importance and had flour and woolen mills, a foundry, and later a timber-sawing industry. It is now the site of a small hydroelectric generating plant that uses the water of the Merced River.

Exchequer Dam, several miles up the Merced River, outside of the survey Area, is the main source of irrigation water for the Area. It also provides supplemental electric power. Both Snelling and Merced Falls were served by the Yosemite Valley Railroad, but this rail service was abandoned in 1946.

The stock ranches are on the saline-alkali soils along the San Joaquin River and on the rolling terraces and uplands in the eastern part of the county. The ranches are large, and the population is sparse. The grain ranches are mainly in the northern and eastern parts of the Area. They are somewhat smaller than the cattle holdings, and the population is little less sparse. The most densely populated farm area is near Atwater, Delhi, and Livingston, where the soils are sandy and orchards, truck farms, vineyards, and pasture predominate. The holdings range from 20 to 100 acres and average 70 acres per farm.

Hopeton, located 6 miles west of Snelling, is one of the oldest towns in the Area. It now has only a half a dozen houses. Dairying and raising alfalfa are the most important enterprises. Atwater, with a population of 2,856, and Livingston, with 1,502 in 1950, are thriving towns on the Southern Pacific Railroad west of Merced. Both are shipping centers for fruits, grapes, and truck crops. Winton, Cressey, Planada, and Le Grand are relatively new towns located on the Atchison, Topeka, and Santa Fe railroad. Winton and Planada have a population of about 500 each and are agricultural communities. Le Grand has a population of 742. It is a center for the eastern grain district of the Area. Athlone is a shipping point on the main line of the Southern Pacific. A small cotton gin is located several miles south of this small settlement. Stevinson, Hilmar, and Irwin are small communities in the southwestern part of the Merced Area, where dairying is the main enterprise. El Nido, south of Merced, is another small community. It has a cotton gin to handle the cotton grown locally. Dairying and alfalfa raising are the primary enterprises.

Industries

The Merced Area has a fruit and vegetable cannery in Planada and one in Tuttle. The Planada cannery cans primarily the locally grown peaches, apricots, and figs. The Tuttle cannery cans fruit and also tomatoes and other vegetables. Planada has several dehydrating plants and drying yards for drying figs produced in that area. Several packing houses located in Atwater and Livingston handle and ship fruit. Grapes are usually dried in the field and processed outside the Area. Two small cotton gins are located within the Merced Area, one at El Nido and the other south of Athlone on U.S. Highway 99. There are also two small rice dryers and an elevator near Merced.

Near Merced there are several manufacturers of concrete pipe, which is needed for the irrigation systems. A woodworking industry between Merced and Atwater serves the local areas and ships to other points. The largest of the industries in the Merced Area are those that provide services to agriculture; they include implement stores, fuel companies, pest control companies, farm supply stores, and farm machinery repair shops. A large number of firms that service agricultural equipment are scattered throughout the Merced Area. Many are located in the smaller communities, but major repairs and maintenance are handled by dealers in or distributors of farm implements in the larger towns.

The packing and canning industries provide work and income for many in both the rural and urban districts. This work, however, is seasonal, and the resulting periods of unemployment are a problem in the local economy.

Transportation

The Merced Area is well supplied with transportation facilities. The first railroad was built down the valley between 1870 and 1874 and arrived at Merced about the year 1872. The main lines of the Santa Fe and Southern Pacific railroads in the San Joaquin Valley, connecting San Francisco and Los Angeles, pass through Merced. The area is linked by both passenger and freight service

with San Francisco, Stockton, and Modesto to the north and Fresno, Bakersfield, and Los Angeles to the south.

U.S. Highway 99, the main artery of motor transportation in the Great Valley of California, passes through Merced in a northwest-southeast direction. It links the major towns and cities of the San Joaquin and Sacramento Valleys with Los Angeles on the south and Oregon and Washington to the north. Three main State highways and many secondary hard-surfaced county roads make an excellent all-year road system. State Highway 140 extends through Merced and Atwater, west to Gustine, and northeast to the Yosemite Valley.

Numerous paved county roads serve the Area and link with the State highways and U.S. Highway 99. More than 90 percent of the farms and ranches are located on hard-surfaced roads, and less than 3 percent are more than half a mile from a hard-surfaced road.

The Merced Area is served by a number of bus lines, both local and transcontinental. Airplane passenger service connects with the main airlines at Los Angeles and San Francisco. Flights to the east are scheduled from Sacramento, San Francisco, and Los Angeles, and there are transoceanic flights daily from San Francisco.

Community Facilities

In the rural areas, the schools, churches, libraries, clinics, and recreational facilities are clustered on the more thickly populated alluvial fans and flood plains. There are few schools and dwellings in the saline-alkali basin and on the range areas of the terraces and uplands. The basin area has grade schools at El Nido and at Stevinson. The range areas on the high terraces and uplands have a few widely scattered schools and have churches in the larger communities. On the low terraces and alluvial fans and flood plains there are numerous grade schools and churches, recreational facilities, and all four of the high schools. Merced High School serves the center of the Area, Le Grand the eastern part, Livingston the northern and west-central part, and Hilmar the western part. There are grammar schools and libraries in practically all of the communities of any size.

Three hospitals are located within the Area. The town of Merced has a county hospital, a privately owned hospital, and several clinics. The Bloss Memorial Hospital in Atwater has additional facilities for the treatment and care of polio patients.

Ninety percent of the farms and ranches in the Area had access to electric lines in 1945, and nearly all were using electricity. In that year, 88 percent of the farms had radios, and running water had been installed on 87 percent of the farms. Only 26 percent of the farms had telephones in 1945, but the percentage was increasing rapidly.

Agriculture

The long, sunny growing season and the widespread practice of irrigation in the Merced Area have made possible the development of a highly specialized, intensive agriculture and the growing of many kinds of crops. According to the Merced County Department of Agriculture's annual report, 66 different crops were grown on a commercial scale in Merced County in 1948. Most of these crops are grown to some extent in the Merced Area.

According to the United States agricultural census of 1945, there were 2,978 farms or ranches in the Merced Area, and they covered 608,193 acres. Of these, 2,499 were operated by owners or part-owners, 61 were operated by managers, and 418 were operated by tenants. The holdings ranged in size from 10 acres to about 30,000 acres.

The larger ranches were in the northern and southern parts of the Area. Those in the northeastern part of the Area averaged 1,050 acres in size. They were primarily cattle and grain ranches, on which 70 percent of the land was in pasture and about 27 percent was in grain or crops. Farms near Atwater, Delhi, Winton, and Cressey averaged 70 acres in size. They were intensively farmed. About 91 percent of the land was in orchards, vineyards, or truck crops, and only a few acres were in range.

Crops

No recent figures are available on production in the Merced Area alone, but it is estimated that half or more of the crops of Merced County are produced in the Area covered by this survey.

Grain

Grain, principally barley, is grown extensively in this Area. Small acreages are planted to wheat and oats. Before 1900, almost all the grain in the Area was wheat, but the local varieties of wheat were soft kerneled, and the demand for this kind of wheat has declined.

Grain is widely grown on hardpan soils of the Rocklin, San Joaquin, Madera, and Yokohl series, and on associated soils of the Whitney, Montpellier, Snelling, and Ryer series. Grain is also grown on Landlow and Burchell soils and to a limited extent on the saline-alkali soils of the Lewis, Fresno, Traver, Rossi, and Waukena series.

Except for a few acres used in rotation for rice and other crops, all of the grain is produced without irrigation. The fields are summer fallowed in alternate years.

The barley grown without irrigation is mostly of the Atlas, Tennessee Winter, and Rojo varieties. Under irrigation, Rojo, Mariout, and Arravet varieties are commonly grown in rotation with milo and cotton.

Experiments by the Merced County Agricultural Extension Service have shown that barley yields can be increased materially on the San Joaquin and other hardpan soils if both nitrogen and phosphorus are added in fertilizer and if there is enough moisture to mature the more vigorous plants that result. Under irrigation, yields are increased by the addition of phosphorus in fertilizer.

Almost all of the grain is harvested by combine. Some is sacked and sold as field run, or cleaned and resacked. Where an elevator is available, bulk handling is becoming more common.

Most of the grain is processed or fed to livestock within the State. Some is sold locally as feed for livestock and poultry. Considerable quantities are trucked to San Francisco. Until a few years ago, grain was shipped to San Francisco by train or by boats on the San Joaquin River.

Rice

The fine-textured soils of the Landlow, Burchell, and Lewis series are well suited to growing rice. Yields are above the average for the State. Most of the rice is grown southwest of Merced. This area is restricted by zoning regulations because a high water table forms where rice is grown. Rice has been planted on smaller areas of saline-alkali Fresno and Waukena soils as part of a reclamation program.

Careful leveling is necessary to prepare fields for rice growing. A system of contour checks or dikes is needed to maintain irrigation water at a uniform depth of between 3 and 7 inches for several months. On the slowly permeable clay or hardpan soils, 4 to 10 acre-feet of water per season is required. The more permeable soils are not suitable for rice, because too much water is needed and too much leaching results.

Immediately after the fields are fully flooded, between April 15 and May 10, presoaked seed is broadcast on the water. When the grain is nearly mature, the fields are slowly drained. As soon as the soil is dry enough to support harvesting equipment, the crop is combined and artificially dried.

Often the fields are fertilized with ammonium sulfate just before seeding or up to 60 days after it. Rush, sedge, water grasses, cattail, tule, and waterplantain are pests in the ricefields. They are partly controlled by regulating the depth of the water and by spraying from airplanes. Grain, cotton, and irrigated pasture are often grown in rotation with rice.

Cotton

All of the cotton grown in this Area is the improved Acala variety, which produces fibers averaging $1\frac{1}{16}$ inches in staple length.

Cotton is grown on the medium-textured Hanford, Pachappa, Burchell, Honcut, Wyman, Yokohl, Yolo, Marguerite, Columbia, Grangeville, and Temple soils and on the fine-textured Burchell, Landlow, and Merced soils. It is also grown, with limited success, on the saline-alkali Traver, Lewis, Fresno, Piper, and Rossi soils.

All cotton is irrigated. It requires from 2 to 4 acre-feet of water per year. One irrigation before seeding, late in March or in April, is common. Furrow irrigation is the most common method. On some saline-alkali soils, the cotton is flat seeded in border checks to avoid accumulation of salts in the furrow banks.

Cotton is grown in rotation with alfalfa, grain, or milo. Some commercial fertilizer is used. A number of insects attack cotton plants, and many farmers dust or spray them. Most of the cotton is ginned outside of the Area.

Other field crops

Some black-eye beans are grown under irrigation on the Hilmar soils. Yields are about ten 100-pound sacks per acre.

Milo maize is grown as a rotation crop, sometimes in the same year that grain is grown. Most of it is grown on the medium-textured and fine-textured soils southeast of Merced. Under single cropping and irrigation, yields may be up to 3,500 pounds per acre. Under the double cropping system, yields are lower. Much of the milo is used locally for poultry feed.

Irrigated oats are grown on the Dinuba and Hilmar soils. Yields average about thirty 90-pound sacks per acre.

Some rye is grown on the sandy Delhi, Atwater, and Hilmar soils, without irrigation. Yields vary but average about seven 125-pound sacks per acre.

Irrigated corn is grown for silage on a variety of soils, but particularly on the Dinuba and Hilmar soils. Yields of about 10 tons per acre are common.

Sudangrass is also grown on the Dinuba, Hilmar, and other soils under irrigation. It furnishes feed for 4 animal units per acre through the summer months.

Sugar beets are planted on the Merced and Temple soils on the San Joaquin River flood plain. Yields are good.

Grapes

The most important fruit crop in the Area is grapes. More than 20 varieties are grown. The principal ones are Thompson for table use, raisins, and wine; Malaga and Tokay for table use; and Carignane, Alican Boushet, Golden Chasselas, Palomino, Zinfandel, and Mission for wine. The highest yields are produced on the sandy Atwater, Delhi, Dinuba, and Snelling soils; 10 to 14 tons per acre of fresh Thompson grapes and about 8 tons of wine grapes are often reported. On the medium-textured Marguerite, Wyman, and Madera soils, yields are lower and the grapes contain less sugar.

The Thompson grapes need to be pruned and trained on stakes or wires. Before the middle of July, they receive 3 or 4 acre-feet of irrigation water, depending on the use intended for the crop. Cutworms and other insects are controlled by spraying or dusting. Nitrogen fertilizer is added. Raisin grapes are dried on paper in the sun or in a dehydrator.

Some Thompson grapes are pressed for wine. Wine grapes are managed like the raisin grapes, except that they receive less fertilizer and they may receive irrigation water until the middle of August. Dusting with insecticides may be necessary to control grape leafhopper and Pacific mite. Wine grapes are trucked to wineries in Modesto, Madera, or Fresno. Wine grapes are not processed in the Merced Area itself.

Early table grapes are shipped to eastern markets by rail.

Almonds

Many varieties of almonds are grown in the Area, but Nonpareil, Mission, and Ne Plus Ultra make up 85 percent of the total. Most orchards contain several varieties for pollination (fig. 4).

Almonds are commonly grown on the sandy Delhi, Atwater, and Snelling soils and on the medium-textured Honcut, Wyman, Yolo, and Marguerite soils. Almonds on the Dinuba and Hilmar and, to some extent, on the Delhi soils show sodium burn on the leaves.

Almond orchards are irrigated several times during the season. A total of $2\frac{1}{2}$ to 3 acre-feet of water per year is applied. Nitrogen benefits the trees, and on some soils potash should be added. Manure and winter cover crops are useful on sandy soils that contain little organic matter. The trees are commonly pruned. Sprays and dusts are used to control red spider, almond mite, San Jose scale, and peach borer. Late spring frosts sometimes damage

the crop. In some areas the trees are protected from frost by smudging or by fanning with wind machines.

Almonds are sold through the California Almond Growers Exchange, through grower cooperatives, or to independent buyers.

Figs

The figs grown for drying are mostly of the Black Mission, Calimyrna, and White Adriatic varieties. In new plantings, Kadota figs for canning are prominent. The White Adriatic figs have continued to be popular, but fewer new trees of the Black Mission and Calimyrna varieties are being planted. Figs are grown mostly near Planada and southeast of Merced, on the medium-textured Yokohl, Honcut, Wyman, Yolo, and Marguerite soils and the fine-textured Porterville, Raynor, Landlow, and Burchell soils. Yields are higher on Wyman silty clay loam than on Porterville clay.

Most of the figs are irrigated. About 2 acre-feet of water per year is used on figs intended for drying, and somewhat more on Kadota figs intended for canning. Water is applied once late in the fall or in winter and two to four more times before August 15. Some nitrogen is added, and on some clay soils gypsum is applied to improve workability.

Kadota fig trees are heavily pruned (fig. 5). This produces low, spreading trees that make picking easier, and it stimulates new growth on which the fruit forms. On the other varieties, the old branches are occasionally thinned.

The difficulty of pollinating the Calimyrna figs has led to experiments with hormone sprays for production of seedless figs. Calimyrna figs must be pollinated by caprification. This consists of placing a few figs of the inedible Capri variety in each tree in order to introduce the fig wasp, the only insect that can pollinate this variety of figs.

Most of the Kadota figs are sold to local canneries, and the dried figs are sold to independent packers and through grower marketing associations. Early figs are shipped to eastern markets.

Peaches

Growing peaches is a major industry in this Area. More than 23 varieties are grown. Gaume, Phillips, Peak, and Paloro are the most popular clingstone varieties, and Elberta and Lovell are the most common freestone varieties. Yields are highest on the sandy Atwater and Delhi soils. They are somewhat lower on the medium-textured Honcut, Wyman, Yolo, and Marguerite soils, and still lower on the clay soils of the Porterville and Burchell series.

On the sandy soils, common management includes frequent irrigations that use up to 4 acre-feet of water per year. Each tree receives 1 to 1½ pounds of nitrogen. From 5 to 10 tons of manure per acre is applied. Rye, vetch, and field peas are grown as winter cover crops in the orchards. Weeds are controlled by clean cultivation. Trees are pruned to increase yields and thinned to prevent overloading and to increase the size and quality of fruit. Props are often used to support the laden branches. Sprays are applied to overcome zinc deficiency in the soil, prevent littleleaf disease, and control insects. Smudging is used in some areas to prevent frost damage during the blossoming period.

Figure 4.—**Almond trees on Honcut soils near Le Grand. Smudge pots protect the trees from frost. Bees are put in the orchard to assist in pollination.**

Some areas of the medium-textured soils have been over-irrigated, cultivated too frequently, and cultivated when too moist. This has caused the formation of a very distinct, tough plow layer that impedes penetration of water and air and reduces the yields.

Most of the peach crop is canned, some locally and some outside the Area. Many tons of peaches are dried, and in increasing amounts the freestone peaches are frozen. A little of the early crop is sold as fresh fruit.

Other fruit and nut crops

Some walnuts are grown in this Area, on the Honcut and Wyman soils east of Merced, on the Delhi and Atwater soils near Livingston, and in a few spots on the Marguerite, Hanford, Hilmar, and Pachappa soils. On the better soils, yields range from 1 to 1½ tons per acre. On soils affected by salts and alkali or a high water table, yields are less than one-half ton per acre.

Apricots are grown on the sandy Atwater and Delhi soils and on the Honcut, Wyman, and Yokohl soils. Few

Figure 5.—**Kadota fig trees on Porterville clay, 0 to 3 percent slopes. The trees are pruned low so that continual harvesting through the summer will be easy.**

new plantings have been made recently. Early apricots are shipped to eastern markets, and others are dried or canned in the Area. A few nectarines are grown for sale as fresh fruit

A few old plantings of olives along streets and borders will produce fruit if irrigated and pruned. Small acreages of persimmons, plums, pomegranates, and prunes are scattered over the Area.

Fresh fruits are trucked to San Francisco. Los Angeles, and other points for marketing.

Sweetpotatoes

The area around Atwater and Ballico is an important center of sweetpotato production in California. Sweetpotatoes are grown only on well-drained sandy or medium-textured soils, mainly those of the Atwater, Delhi, and Hilmar series. The common varieties are Red Porto Rico, Yellow Jersey, and Hawaiian.

Growing sweetpotatoes is complicated and expensive (*16*). Rotation with other crops is essential to keep diseases and pests in check. Wireworms and rootknot nematodes are common; soil fumigants are sometimes used to control them. Poisoned bait is used to control cutworms. Sweetpotatoes should not be grown oftener than once in 3 years on the same field.

The seedroots are sprouted in hotbeds and transplanted to the fields. Fields must be cultivated carefully, to avoid too much disturbance of the vines. Nitrogen is commonly applied, and on some of the sandier soils a complete mixed fertilizer is used. Irrigation is used to maintain good moisture conditions. Up to 2½ acre-feet of irrigation water is applied, in as many as eight light irrigations per season.

The roots are harvested carefully with diggers. They are sorted and stored in cellars or insulated storage houses where they will not be chilled below 50° F. Spoilage caused by stem rot, black rot, and other diseases is controlled by special precautions in handling the seedroots and in storage. Sweetpotatoes should be handled and processed rapidly or used immediately after they are removed from storage. Because of the danger of loss in storage, the price of sweetpotatoes increases materially late in fall and in winter.

Tomatoes

The most important vegetable crop grown in the Merced Area is tomatoes. The best yields are obtained on the Honcut and Yolo soils, but the Wyman, Marguerite, Burchell, and Grangeville soils are also used.

Closely spaced plants are trained onto stakes for better quality, easier picking, and increased yield. Part of the crop is shipped as fresh tomatoes, and part is canned locally.

Other truck crops

Watermelons, cantaloups, casabas, Persian melons, honeydews, and Cranshaw melons are grown mostly on the sandy Delhi, Atwater, and Hilmar soils. Watermelons are seeded in March and April and picked through August and September. Difficulties with insects and wilt disease have made long rotations necessary. Most of the crop is trucked to market.

Bell peppers and onions are important vegetable crops, and some bush berries and strawberries are grown. Small acreages of other vegetables are produced near Merced on the Honcut and Wyman soils or in a few places along the Merced River bottom land.

Fresh vegetables are trucked to markets in San Francisco, Los Angeles, and other towns nearby.

Alfalfa

Alfalfa is the most extensively grown irrigated crop in the Merced Area. It is grown on many different soils, including the sandy Delhi, Atwater, and Dinuba soils, the medium-textured Honcut, Wyman, Hanford, Grangeville, Pachappa, Yolo, Marguerite, and Columbia soils, and the fine-textured Burchell and Landlow soils. Yields are 4 or 5 tons per acre on the sandy soils and about 6 or 7 tons on the medium-textured and fine-textured soils. Yields of more than 8 tons have been recorded where phosphate fertilizer has been used.[2] Yields are lower where the soil contains salts or alkali.

The average life of a stand of alfalfa is 6 or 7 years, but stands on sandy soils may last only 4 or 5 years. From five to seven cuttings are made in one season. The hay of best quality is generally cut during the second and third years. Commercial fertilizer and manure increase yields and prolong the stand. Phosphate is most commonly used. Sulfur or gypsum increases yields on sandy soils. Alfalfa is irrigated after each cutting, and on the sandier soils every 2 or 3 weeks. In most places 3 to 4 acre-feet of water per year is applied, but on the Merced River bottom land less surface irrigation is needed. Russian knapweed is a serious pest. Other weeds that give trouble are sandbur, bermudagrass, and johnsongrass.

Most of the alfalfa is used locally. Part of it is baled. Some is field chopped and blown into wagon bins. On dairy farms much of the alfalfa is used for pasture.

Grain hay

Irrigated grain hay, generally oats or barley, is usually grown in rotation with other crops, such as irrigated pasture, alfalfa, or silage corn. Often it is added to the rotation to control weeds in other crops.

Unirrigated grain may be cut for hay if adverse weather conditions—usually drought—make it probable that the yield of grain will be too small to harvest profitably.

A large part of the grain hay produced is fed locally to dairy cattle. Some is baled, and some is grazed. The straw from the harvested grainfields is often baled and sold for bedding or feed.

Irrigated Pasture

The acreage of irrigated pasture in the Merced Area has been increasing and is now nearly four times that of 15 years ago. A large area of irrigated pasture lies west of Hilmar and extends through the area around Stevinson, on the Hilmar soils. There are many large irrigated pastures near Merced, on the fine-textured Yokohl and Burchell soils. Some are on the Atwater and San Joaquin soils north of Merced, and some are on the Snelling and Greenfield soils around Amsterdam.

[2] HORTON, D. R., WOLFE, M. J. THE EFFECT OF PHOSPHATE FERTILIZERS ON YIELD AND PROTEIN CONTENT OF ALFALFA HAY IN MERCED COUNTY. Merced County Agr. Ext. Serv., Univ. of Calif. February 1949. (Mimeographed.)

The mixture of legumes and grasses recommended by the Merced County Farm Advisor for each acre of well-drained soil is as follows: ladino clover, 3 pounds; alfalfa, 3 pounds; perennial ryegrass, 6 pounds; orchardgrass, 3 pounds; Kentucky bluegrass, 3 pounds; birdsfoot trefoil, 1 pound; dallisgrass, 4 pounds. The mixture recommended for wet and marshy soils is as follows: ladino clover or strawberry clover, 2 pounds; birdsfoot trefoil, 2 pounds; ryegrass, 4 pounds; and dallisgrass, 5 pounds. Ladino clover is the legume most commonly used in pasture mixtures. Burclover is included in some mixtures because it grows during winter and supplies a legume early in spring. Birdsfoot trefoil is used in wet areas where alfalfa is likely to drown out.

Pastures are irrigated by the border check, contour check, or wild flooding methods. Topography, soil texture, and availability of water govern the selection of the irrigation method. Many of the forage plants used are shallow rooted, and they need water frequently. Fields are irrigated about 14 times during the season, at intervals of 10 to 14 days.

The production per acre depends partly on the kind, quality, and age of the livestock pastured. An acre of good pasture, properly managed and used to capacity, should produce 400 or more pounds of meat per year.[3]

The average carrying capacity of the pastures during the irrigation season is one animal unit per acre. During the rest of the year, it is 0.4 animal unit per acre. In general, the higher the capacity of the pasture, if fully used, the lower will be the total cost per animal per month.[4]

The average irrigated pasture represents an investment of about $90 per acre. About $60 of this is for land, and about $30 is for fencing, leveling, ditching, and other facilities. Labor and water costs are the most important cash expenses each year.

Range Pasture

About half of the Merced Area is used for range pasture. A broad band of intensively farmed soils that runs through the center of the Area from east to west separates the two chief kinds of rangeland. The range on the terraces and uplands covers about 274 square miles, or that quarter of the Area that lies north and northeast of the town of Merced. The range in the saline-alkali basin and on the flood plains covers about 227 square miles, or that quarter of the Area that lies south and southwest of the town of Merced.

On the well-drained, medium-textured Redding, Corning, Pentz, Amador, Daulton, Whiterock, Hornitos, and Whitney soils of the uplands and terraces, four species of plants produce the majority of the forage. Alfileria is dominant, and, with soft chess, foxtail fescue, and wild oats, it makes up most of the cover. The same plants are common on the acid, fine-textured Peters, Yokohl, Exchequer, and Auburn soils of the uplands and terraces, but wild oats is dominant instead of alfileria. The slightly calcareous, fine-textured Raynor, Seville, and Hopeton soils have an abundance of burclover. The Amador soils, which are generally strongly acid and very shallow, support little besides alfileria. The Marguerite, Whitney, Madera, and Yokohl soils on the terraces produce good forage, but they are better suited to crops or to irrigated pasture than to range. The San Joaquin soils dry rapidly because they are shallow and sandy. They are used primarily for grain and are only fair for range. The Corning, Redding, and Seville soils of the older terraces are limited in suitability; they are almost entirely in range of fair carrying capacity.

On most of the basin soils, saltgrass and foxtail fescue are the dominant grasses. Cattail and tule are common in the ponded and swampy spots. Iodinebush, alkali mallow, and alkali heath grow in the strongly saline-alkali areas. The flood-plain soils of the Columbia, Temple, and Merced series are covered with lippia and saltgrass.

The poorly drained and somewhat poorly drained soils in the basin are affected by concentrations of salts and alkali caused by intermittent ponding and a high water table. Saltgrass grows abundantly on these wet soils. It will carry cattle longer into the summer than forage from the drier range on the terraces and uplands. The quality and carrying capacity of the range forage are better where salts and alkali are less concentrated and not so good where salts and alkali are more concentrated.

The Dinuba, Hilmar, Traver, Fresno, Waukena, and Piper soils have a sandy surface texture. The Lewis, Rossi, Burchell, Landlow, Temple, and Merced soils near Merced and along the flood plain of the San Joaquin River have a clay loam or clay (adobe) texture.

In general, the medium-textured soils that have only slight concentrations of salts and alkali and have no hardpan produce a good cover of saltgrass and have a good carrying capacity. Sandy soils, soils that have moderate concentrations of salts and alkali, and soils that have a hardpan produce fair range. Strongly saline-alkali soils produce little saltgrass and make poor range.

Soils that have a good range carrying capacity produce 20 to 30 cow-acre-days of forage per year; that is, they would support 1 mature cow on each acre for 20 to 30 days of each year. It would take 12 to 18 acres of this kind of range to support one cow the year round. Soils that have good estimated carrying capacity are the Hopeton, Peters, and Raynor soils on the uplands, the Madera, Marguerite, Whitney, and Yokohl soils on the terraces; and the Burchell, Columbia, Landlow, Lewis, Piper, Rossi, Temple, and Waukena soils in the basin part of the Area. The Lewis, Piper, Rossi, and Waukena soils are slightly saline-alkali.

Soils that are only fair in range carrying capacity produce 12 to 20 cow-acre-days of forage. It would take 18 to 30 acres to support one cow. Soils that have fair carrying capacity are the Auburn, Daulton, Exchequer, Hornitos, Pentz, and Whiterock soils on the uplands; the Corning, San Joaquin, and Seville soils, and the Redding soils at less than 500 feet elevation on the terraces; and the Dinuba, Fresno, Hilmar, Lewis, Merced, Piper, Rossi, Traver, and Waukena soils in the basin. The Dinuba, Fresno, Hilmar, and Traver soils are slightly to moderately saline-alkali. The Lewis, Piper, and Waukena soils are moderately saline-alkali. The Rossi soils are moderately to strongly

[3] UNIVERSITY OF CALIFORNIA AGRICULTURAL EXTENSION SERVICE, MERCED COUNTY OFFICE. SUMMARY OF RESULTS FROM PASTURING COWS AND CALVES ON IRRIGATED PASTURE, CROCKER-HUFFMAN RANCH, MERCED COUNTY. 3 pp. 1939.

[4] UNIVERSITY OF CALIFORNIA AGRICULTURAL EXTENSION SERVICE, MERCED COUNTY OFFICE. IRRIGATED PASTURE MANAGEMENT STUDY FOR MERCED COUNTY. 8 pp. 1940. (Mimeographed.)

saline-alkali. The Merced soils are slightly to moderately saline.

Soils that have poor carrying capacity produce only 7.5 to 12 cow-acre-days of forage. It would take 30 to 50 acres to support one cow. The Amador soils on the uplands and the Redding soils at more than 500 feet elevation on the terraces have poor carrying capacity. The strongly saline-alkali Dinuba, Fresno, Hilmar, Lewis, Piper, Traver, and Waukena soils of the basin also have poor carrying capacity.

Livestock

Raising cattle is the most important livestock enterprise in the Merced Area. Beef cattle have been more numerous than dairy cattle since about 1950; before that, there were more dairy cattle in the Area.

About two-thirds of the Merced Area is used to pasture livestock. Most of the winter and spring feed comes from range, and the summer feed from irrigated pasture. Some dry saltgrass range is used to pasture beef cattle and dry dairy cattle in the summer. A balance of 1 acre of irrigated pasture for each 10 acres of dry range is about right for keeping the irrigated pasture in good condition while raising cattle. Beef cattle are generally kept on range from October or November to May. Under better management they are moved back to irrigated pasture in the middle of April.

In dry years, supplemental feed is needed in November and December to carry the cattle over until the range grasses can support them. Alfalfa hay and cottonseed meal or cake are the main supplemental feeds. Neither are raised on the farms but are bought locally. The cattle industry uses more alfalfa than is produced in the Area, and a considerable tonnage is purchased elsewhere. A large proportion of the grain produced also is used in dairy farming.

Most of the beef cattle are Herefords. Some are Aberdeen Angus or shorthorns. Braford cattle, a cross between Brahma and Hereford, are finding favor as a breed that can withstand summer heat better and gain more weight during summer than other breeds.

Beef cattle are shipped long distances to market by railroad. For distances up to 500 miles, the use of trucks is increasing. Cattle hauled by truck can be picked up from the field, and this reduces the shipping time and minimizes weight loss in shipment.

Most of the dairy cattle are Holstein-Friesians. Guernseys and Jerseys are also popular. About 15 percent of the herds are purebred, but a much larger proportion use purebred bulls. The largest dairy herds are on farms southwest of Snelling, along the bottom lands of the Merced River.

Marketing of milk and processing of butter and cheese is done outside the Area, mostly in the San Francisco Bay area. In Merced, a branch of a large creamery distributes bottled milk, but it does not buy milk. One small local creamery in Merced handles bulk milk and produces ice cream. Large dairies and creameries outside the Area distribute milk locally.

Raising turkeys is another major livestock enterprise. Most of the turkeys in the county are raised in the Merced Area. About 10 times as many turkeys are produced in the Area as were produced 20 years ago. In 1944 the average flock consisted of 1,650 turkeys, but it is estimated that the average turkey farm now has more than 3,000 birds. Most of them are of the Bronze and Broad-breasted Bronze types. Most turkeys are raised on sandy, well-drained soils in the Delhi, Atwater, Winton, and Livingston areas. Feed usually is not produced on the turkey farm but is purchased. Poultry uses a large amount of the milo produced in the Area.

Only a few turkeys are processed by local packers. Most of them are shipped alive by truck to large packing houses to the north and south of the Area. The sale of turkey eggs is also important. Some are sold locally and some are shipped to eastern hatcheries.

Raising chickens and selling eggs is a minor enterprise, except around Delhi, where it is locally important.

Some hogs are raised in the southeastern corner of the Area. The common breeds are Hampshire, Duroc-Jersey, and Poland-China. Grain is the chief crop on these farms, and the hogs graze the grain stubble after harvest.

There are about five sheep ranches in the Area. It is estimated that less than 2,000 head of sheep are raised.

Irrigation and Drainage

The average yearly rainfall in the Merced Area is less than 12 inches. Only about 15 percent of this falls during the growing season. Most summer storms yield less than a quarter of an inch of rain. In many years, the annual rainfall is not enough to mature dry-farmed grain or grain hay. Irrigation is necessary to support the highly intensified and diversified types of agriculture.

Little of the water supply for crops of this Area comes directly from precipitation. Most of it is ground water pumped from wells or snowmelt diverted from streams. Two major tributaries of the San Joaquin River, the Tuolumne and the Merced Rivers, provide most of the irrigation water for the Merced Area. The smaller creeks in the Area are intermittent and do not provide storage or dependable natural flow for irrigation.

The Tuolumne River is the largest tributary of the San Joaquin River. It does not flow through the Merced Area, but it supplies surface water for irrigation of land near Turlock, in the northern and western part of the Merced Area. It drains an area of 1,680 square miles. The average runoff over a long period of years has been about 2,000,000 acre-feet of water per year. The runoff varies considerably from one year to another. In wet years it may amount to 5,000,000 acre-feet, but in dry years it has been as little as 500,000 acre-feet. This wide variation in runoff makes it necessary to control the supply by storing water from wet years to dry years. Turlock Reservoir and Don Pedro Reservoir, both located north of the county, store water from Tuolumne River for irrigation.

The Merced River, which runs through the northern part of the Area, is also a major tributary of the San Joaquin River. It supplies both surface water and underground water for irrigation in the Area. It drains an area of 1,034 square miles. It has an average runoff of 983,000 acre-feet per year, but during the past fifty years it has varied from a minimum of 264,500 acre-feet to a maximum of 2,108,100 acre-feet. Exchequer Dam, in the mountains east of the Area, impounds water from the Merced River for irrigation in the Merced Area.

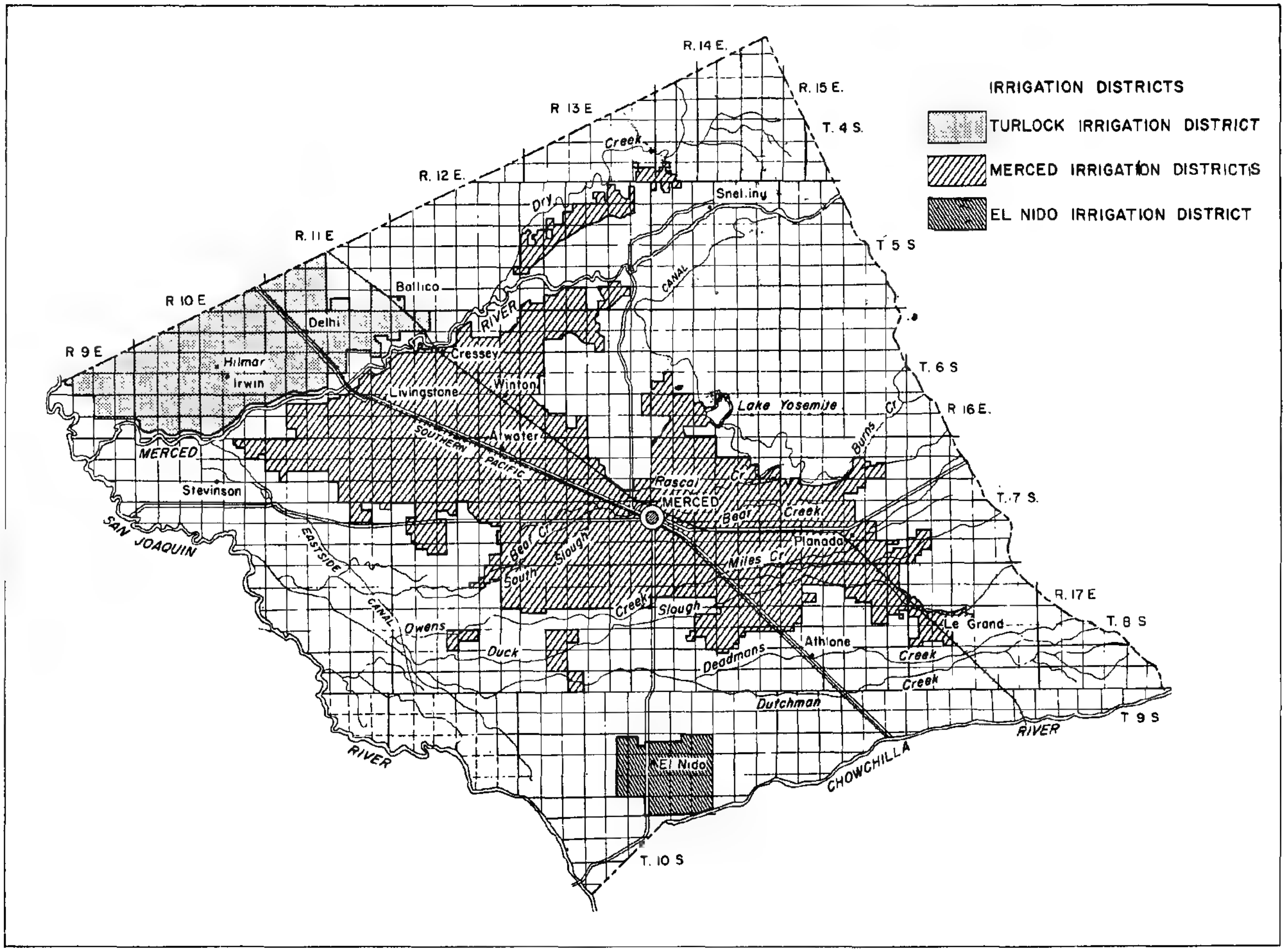

Figure 6.—**Land covered by irrigation districts in the Merced Area.**

Irrigation in the Merced Area began in 1888. The Crocker Huffman Land and Water Company was the first company to furnish water to this Area. It used water from the Merced River. The area irrigated was relatively small. It was located in the southern and western parts of the present Merced Irrigation District.

The Turlock Irrigation District was organized at about the same time as the Crocker Huffman Land and Water Company, but it did not deliver water until 1901. A dam was constructed across the Tuolumne River above the town of La Grange in 1893. Davis Reservoir, now renamed Owens Reservoir, was constructed in 1913 to store additional water for use in July and August. The greatly increased demand for water and the large seasonal variation in runoff led to the construction of Don Pedro Dam in 1922. This dam, 284 feet in height, controls floods on the Tuolumne River and stores water for irrigation through dry climatic cycles. About 27 percent of the Turlock Irrigation District lies within the Merced Area. It furnishes water to about 42,000 acres in the Area (fig. 6). After the addition of several thousand acres north of Ballico, no further expansion of the Turlock district is contemplated.[5] No incorporated towns of the Merced Area are within the Turlock Irrigation District, but the unincorporated towns of Ballico, Delhi, Hilmar, and Irwin receive water from it.

The lands served by the Turlock district, with the exception of an area around Delhi, have access to the cheapest water of any irrigation district in the entire San Joaquin Valley. They receive water at an average cost of 30 to 50 cents per acre-foot and have a tax rate of $1.10 per $100 assessed valuation. This low tax rate for water is made possible by the wholesale and retail sale of electric power generated at Don Pedro Dam and other sources.

The Merced Irrigation District was organized in 1919. At first it covered 173,000 acres. In 1922 the Crocker Huffman system, which covered another 50,000 acres, was purchased. Exchequer Dam was constructed on the Merced River a few miles north of Merced Falls in 1926,

[5] Data from mimeographed leaflet issued by the Turlock Irrigation District. R. V. Meckle, engineer. March 1948.

Figure 7.—**The canal of the Merced Irrigation District. In the background are high terraces of Redding gravelly loam, 0 to 8 percent slopes.**

and the district operated with increased storage facilities the next year. In 1940 the acreage within the district was cut to 164,395 acres by excluding marginal and other lands that were unprofitable to the district because of the cost of delivering water.

At present, the Merced Irrigation District serves about 25 percent of the Merced Area (fig. 7). It extends from the edge of the Sierra Nevada foothills on the east, through the center of the Area, toward the San Joaquin River on the west, and from the Merced River on the north to Deadman Creek on the south. The incorporated cities within the district are Merced, Atwater, and Livingston, and the unincorporated towns are Winton, Cressey, Planada, and Le Grand. In 1947, there were 104,180 acres irrigated directly from the Merced irrigation system, and 5,950 acres irrigated from private pumps, making a total of 110,130 acres irrigated within the district. It is estimated that about 18,900 more acres could be brought under cultivation by irrigation from this district. However, no further expansion is now contemplated.[6]

The Merced district has a tax rate of $3.50 per $100 assessed valuation. It delivers water to the land at an average cost of $1.00 per acre-foot.

The El Nido Irrigation District lies south of Merced, just north of the Chowchilla River. It contains 9,162 acres. It was organized in 1929, and the canals were completed and delivering water in 1932. The district was formed with the hope that excess water might be obtained from the Merced Irrigation District, but the amount received has been small and somewhat variable. In 1947, 1948, and 1949, the amounts were 1,744 acre-feet, 2,194 acre-feet, and 2,587 acre-feet, respectively. Most of the irrigation water used in the El Nido Irrigation District comes from the underground water supply.

The North Side Canal District lies west of Snelling, between Dry Creek and the north side of the Merced River. It serves about 5,800 acres.

The Stevinson Water District lies along the south side of the Merced River in the western part of the Merced Area. Its acreage is about the same as that of the North Side Canal District. It uses excess water and drainage water from the Merced Irrigation District.

The most common methods of irrigation in the Area are the furrow, border check, basin check, and contour check methods. All of these work on the same principle—water is turned in at the upper end of the field and flows to the lower end, where it is drained back into the irrigation system or into drainage ditches. Sprinklers have been used very little, but they could be used on orchards, grain, and irrigated pasture where the topography is too rolling for the usual methods of irrigation.

Most areas have surface irrigation (fig. 8). Furrow irrigation is most commonly used on row crops. The length of the furrow depends on the texture of the soil and the slope.

[6] Data from "Merced Irrigation District Report to the Directors." Mimeographed. May 1948.

Border check flooding is used primarily on crops that need large quantities of water and little cultivation. The field is flooded in bands 10 to 60 feet wide between parallel ridges. The distance between checks depends on the texture of the soil and the slope. Border checks are used for cotton on saline-alkali soils. Irrigation by this method tends to wash some of the salts out of the surface soil, to reduce the concentration of salts at the tops of the ridges, and to reduce salt injury to germinating plants.

Basin check irrigation—flooding in square or rectangular plots separated by ridges—is used primarily in orchards. It helps prevent wind erosion on the sandy soils on which many orchards are grown. This system has the advantage of concentrating the water in the root zone of each individual tree.

In the contour check method of irrigation, the area is divided into a series of irregular areas by ridges that follow lines of equal elevation. This method, alone or in combination with other methods, is used in orchards and irrigated pastures where the slope is such that it is not possible to distribute water by furrows without causing erosion (fig. 9).

Wild flooding is used on a few pasture areas. This method of irrigation consists merely of turning water onto the soil without leveling. Only a few ridges and weirs are installed to control the distribution of water over the surface.

The contour border check system is used on both nearly level and gently sloping areas. Almost all rice is grown under this system of irrigation.

The chief problems in irrigation are to get complete coverage of the field, to wet the soil uniformly over the field, and to prevent the excess water from standing too long on the lower part of the field or from raising the water table too much.

The average amount of water needed by crops is 3.5 acre-feet per season. The individual requirements vary.

TABLE 3.—*Water requirements of the principal crops,*[1] *and suitable irrigation methods for each crop*

Crop	Water requirement	Irrigation method
	Acre-feet	
Alfalfa	3 to 4	Border check.
Almonds	2 to 3	Furrow, basin check, or contour check.
Apricots	2 to 3½	Furrow or basin check.
Beans	2	Furrow or border check.
Cotton	2 to 4	Furrow or border check.
Figs	2 to 2½	Furrow.
Grapes	2	Furrow.
Milo	1	Furrow.
Peaches	3 to 4	Furrow, basin check, or contour check.
Pasture	3 to 6	Border check or contour check.
Rice	4 to 6	Contour check.
Silage corn	2 to 3	Furrow.
Sudan pasture	2 to 3	Border check.
Sugar beets	3	Furrow.
Sweetpotatoes	2 to 3	Furrow.
Tomatoes	2 to 3	Furrow.
Vegetables	4	Furrow.
Walnuts	2 to 3	Basin check.

[1] Data from mimeographed leaflets of the Merced and Turlock Irrigation Districts.

Figure 8.—**Irrigation ditches lined with cement to conserve water.**

Pasture uses the greatest amount of irrigation water—about 5 to 6 acre-feet of water per year are applied over an area of about 26,000 acres, although this may be more than is actually needed. Table 3 shows the amount of water generally required for the crops common to the Merced Area and the methods of irrigation used.

Unless the supply of irrigation water is exceptionally scanty, drainage is necessary in at least a few places in or near the areas irrigated. The greatest difficulties with drainage are not caused by the flow of underground water from upper elevations but from deep percolation of irrigation water from nearby areas. About 30 percent of the water applied for irrigation is lost by deep percolation.

Records are kept on the depth to the water table by means of many test wells, which are 2 inches in diameter and are located within all of the problem areas. The average depth to the water table depends on the deep percolation of the irrigation water applied to nearby areas and on the unpredictable annual precipitation. The water table is at a greater depth during dry years, and it is nearer the surface during wet years. During the irrigation season, the depth to the water table in the Merced Irrigation District is between 6 and 7 feet; during the winter, it is between 7 and 8 feet.

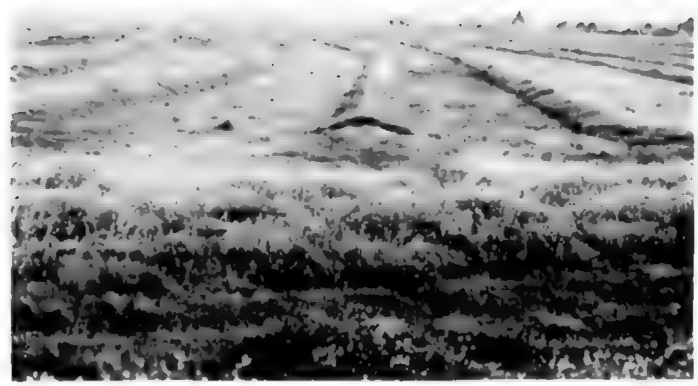

Figure 9.—**Contour irrigation of pasture east of Planada. Soils are Redding gravelly loam, 0 to 8 percent slopes, and Raynor clay, 3 to 8 percent slopes.**

Most of the drainage wells in the Area are 18 to 24 inches in diameter and 100 to 150 feet deep. The average lift is 42 feet. A perforated casing and a gravel envelope to a depth of 20 feet will collect considerable percolating water from the upper strata. In sandy soils such a well very rapidly lowers the water table within a radius of one-half mile. In fine-textured soils the effective radius is about three-eighths of a mile. Electrically driven turbine pumps are most commonly used and are most economical to operate.

Many drainage pumps operate only during the irrigation season and pump the water directly back into the irrigation system. Many other pumps that are located where the water table is high must operate the year round to keep the water table down. The water is pumped into drainage ditches and is lost to irrigation. About 20 percent of the water pumped for drainage is wasted because it is pumped during the winter. The irrigation districts plan to encourage private pumping of water for irrigation both inside and outside of the districts. They hope that the water table will be lowered enough by the end of each growing season so that the expense and waste of water involved in pumping for drainage during the winter will not be necessary.

When the Merced Irrigation District took over the Crocker Huffman system in 1922, it assumed responsibility for the maintenance of adequate drainage for the Atwater and Livingston areas. Although under no legal obligation to maintain good drainage, the Crocker Huffman company had had a drainage system that consisted of a series of open ditches and natural drains. These open drains could not control the water table over a large enough area to justify their heavy maintenance cost. They were satisfactory for control of local surface drainage, however, and a few of them are still used. This district now has 109 drainage wells with pumps to lower and control the water table and to improve drainage.

In the Turlock District, as early as 1917, the water table had risen in many areas to within 4 feet of the surface, and many ponds had appeared. This problem was caused by the use of unlined irrigation ditches and the tendency to overirrigate during the early part of the growing season. There are now 168 drainage wells in the Turlock Irrigation District, and about 20 percent of them are within the Merced Area.

The area southwest of Livingston that extends beyond the Stevinson Colony to the flood plain of the San Joaquin River has a serious problem of drainage. Part of this area lies within the Merced Irrigation District. The drainage pumps of the Merced district have helped considerably in keeping down the water table. The area outside the Merced district does not now have an adequate drainage system, but a more extensive one is planned.

If irrigation water is pumped from wells, the chief problem is not that of a high water table and a need for drainage, but rather that of a water table that has been lowered so much that the pumping lift has become expensive. The El Nido Irrigation District uses well water almost entirely. It receives a little drainage and seepage water from the Merced Irrigation District. Ten electric pumps that have a total of 190 horsepower and an average lift of 69 feet are used to pump irrigation water from wells. The water table is now receding in all parts of the district. In 1932 it stood at an average depth of 40.2 feet. The greatest drop came during the very dry years of 1947 and 1948, and the depth averaged 62.3 feet in 1949. At the time of this survey, it was 50.75 feet. There is no drainage problem, and no drainage pumps or ditches are used. The cost of pumping irrigation water has been increasing because of the increasing depth to the water table.

The average depth to the water table increases from west to east through the Merced Area. It is 4 to 10 feet at the San Joaquin River, and 60 to 80 feet on the high terrace east of Merced. At one time the basin part of the Merced Area contained artesian wells, but only one is still flowing.

Electric rotary pumps of the turbine type are used primarily for deep irrigation wells, but many centrifugal pumps are used for shallow wells, and many pumps are powered by Diesel engines. The average cost of electricity for pumping water is estimated at 2 cents per acre-foot of water per foot of lift. This makes the average cost of pumped irrigation water in the Merced Area about $1 per acre-foot. The cost is higher where depth to the water table is greater and lower where the water table is nearer the surface.

The quality of well water in the eastern half of the Merced Area is generally good. In the western half, however, the water from shallow wells in the basin area near the San Joaquin River contains a considerable quantity of salts and is injurious to crops. Wells have been drilled to a depth of 100 to 150 feet near Merced, to a depth of 300 feet near Le Grand, and to a depth of 850 feet near the Turner Ranch at the extreme western edge of the Area, in order to get good irrigation water.

Flooding is a problem in some parts of the Merced Area. Figure 10 shows the areas flooded during the rainy years of 1937 and 1938. It also shows the areas that would probably be under water during a major flood.[7]

A project now being constructed will include flood control reservoirs on Burns, Bear, Owens, and Mariposa Creeks. Intercepting canals will divert floodwater from Black Rascal Creek to Bear Creek and from Owens Creek to Mariposa Creek. Miles Creek will be enlarged. No flood control project has yet been authorized for the Chowchilla River.

Rain floods ordinarily occur late in fall, in winter, and early in spring. They are characterized by relatively short, heavy flows that are extensively destructive. Near the foothills, the flooding lasts only a short time, but in the intermediate flood plain it lasts for several days, and in the low flat areas next to the stream it may remain for several weeks. Growing crops are washed out or drowned, and livestock drown. Even moderate flooding reduces crop yields and lowers the quality of crops. Rain floods may carry large amounts of silt that results from bank cutting, gullying, and surface scouring. This silt is deposited on cropland and in suburban and urban areas. Considerable damage is done to roads, bridges, and other utilities. Frequent floods in the Merced Irrigation District have increased the already serious problem of a high water table.

Floods from snowmelt runoff occur on the Merced River flood plain. Late in spring, melting snow results in a

[7] This information was furnished by the Sacramento District Engineer, Dept. of Army, Corps of Engineers.

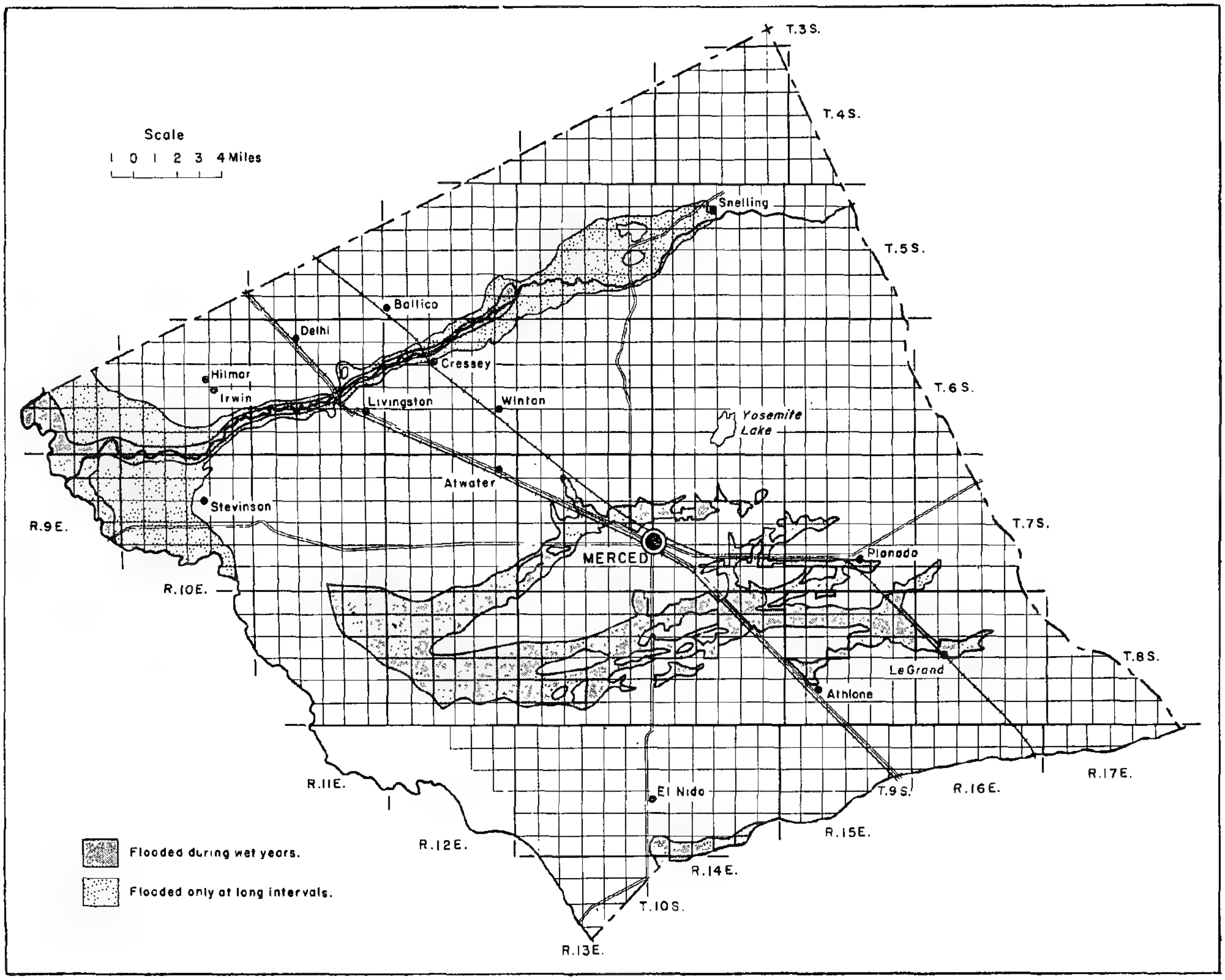

Figure 10.—Extent of flooding in the Merced Area.

sustained flow of water, which may last as long as 2 months. These floods inundate crops, prevent planting, and cause seepage in nearby areas. They weaken and overtop levees, wash away soil, and damage property.

Salts and Alkali

Many soils in the Merced Area contain excess salts, excess alkali, or both. Most areas of such soils are located west of the Southern Pacific railroad, south of the town of Merced.

Saline soils, which contain an excess of neutral salts, are called "white alkali" soils, because of the white crusts of salt that accumulate on the surface in some spots. Soils that contain an excess of alkaline salts, adsorbed sodium (alkali), or both, are "black alkali" soils. They can be distinguished by dark-brown or black stains that appear at the surface in some places. The dark color is caused by a chemically dissolved, dark-colored, organic scum.

A few spots of strongly saline soils lie southwest of El Nido. They have well-developed salt crusts that contain sodium chloride. These neutral salts make the soil puffy, loose, and powdery. The Piper, Merced, and Waukena soils near the Turner Ranch on the San Joaquin River flood plain have this appearance. Neutral salts affect the nutritive balance of plants, especially with respect to potassium and calcium, and restrict their ability to absorb water from the soil. In strong concentrations, they are toxic to plants. The effects are particularly serious at the time of germination. Many plants develop chlorosis, or lack of green pigment, especially if the soil contains considerable lime or gypsum. Some species of plants show characteristic necrotic areas or dead spots, tip burn, and firing of the margins of the leaves. If

salts are concentrated on the surface at the time of germination, the field may have bare spots surrounded by full-sized, vigorous plants.

Alkaline salts are distinctly harmful to many plants, even at low concentrations. Soils that are high in adsorbed sodium tend to run together badly when irrigated, because of the high degree of dispersion of the clay in the soil. Water penetration may be reduced almost to zero. When the surface dries, it may be so hard and dense that it breaks up into large, hard clods and is difficult to work.

The tolerance of various crops for salinity varies considerably, but the tolerance of a given crop for neutral salts is considerably greater than it is for alkaline salts. Most field crops tolerate about twice as much neutral salts as alkaline salts. The relative tolerance of various crops for salts is shown in the following tabulation (*31*).

Good Salt Tolerance:
- Fruit crops: None.
- Field and truck crops: Sugar beets, garden beets, milo, rape, kale, cotton.
- Forage crops: Saltgrass, alkali sacaton, bermudagrass, Rhodesgrass, wildrye, western wheatgrass.

Moderate Salt Tolerance:
- Fruit crops: Figs, olives, grapes.
- Field and truck crops: Flax, tomatoes, asparagus, sorghum, barley, rye, oats, rice, cantaloup, lettuce, sunflowers, carrots, spinach, squash, onions, peppers, wheat.
- Forage crops: Sweetclover, perennial rye, birdsfoot trefoil, strawberry clover, dallisgrass, sudangrass, alfalfa, orchardgrass, blue grama, reed canarygrass, sourclover.

Poor Salt Tolerance:
- Fruit crops: Pears, almonds, apricots, peaches, plums, apples.
- Field and truck crops: Vetch, peas, celery, cabbage, eggplant, sweetpotatoes, potatoes, green beans.
- Forage crops: White dutch clover, meadow foxtail, alsike clover, red clover, ladino clover, burnet.

Saline or alkali soils can be identified by the appearance of the soils or of the crops on them. Crop yields are limited, germination is likely to be spotty, and plants show characteristic defects. The color of the soil or the presence of salt crusts indicates salinity. The structure and consistence of the soil is generally such that water penetrates very slowly and proper moisture conditions are difficult to maintain.

To check on the field observations in this survey and to maintain a uniform standard of mapping, samples were taken in a number of places to a depth of 60 inches, or to the effective depth of the soil if that was limited by a claypan, hardpan, or other horizon that restricted root growth. The percentage of total salts, based on air-dry soil, was determined by measurement of the electrical conductivity of a water-saturated soil paste, using a Wheatstone electrolytic bridge.

Slightly saline-alkali soils contain 0.15 to 0.4 percent of salts. The pH is above 8.3. On the range, these soils can be recognized by the presence of salt-tolerant grasses such as saltgrass, bermudagrass, and foxtail. In some spots, growth is reduced, or slight accumulations of salts that are stained brown with organic matter are present on the surface. In other spots, grasses and plants that tolerate salts poorly may be able to grow. Where the microrelief is hummocky, the salt-tolerant plants may be concentrated at the edges of, on the tops of, or in the areas between the mounds, and the rest of the area may be covered by less salt-tolerant plants.

If slightly saline-alkali soils are cultivated, slight accumulations of salt show in the checks or furrow banks. Even salt-tolerant crops grow in a somewhat spotty pattern, and germination is irregular. Moisture does not penetrate evenly into the soil. Salt-tolerant weeds such as alkali mallow or alkaliweed are likely to be present.

Moderately saline-alkali soils contain 0.4 to 0.8 percent of salts. Their pH is above 8.3. Saltgrass and alkali sacaton are the most common grasses. Saltbush, greasewood, samphire, alkaliweed, and iodine bush are also characteristic. Uncultivated areas support a fair to good growth of these salt-tolerant plants. Only small spots support plants that are not salt-tolerant. Many spots are salt encrusted and bare of vegetation, but they occupy only a small proportion of the area.

If these soils are cultivated, the crops are stunted, and many spots are entirely bare. The plants show dead spots, tip burn, or fired edges on their leaves. Black or brown organic scum appears on the surface of the soil. Water penetration is generally very irregular, except in the coarsest textured soils. On finer textured soils, there may be almost no penetration of water below the cultivated zone.

Strongly saline-alkali soils contain more than 0.8 percent of salts. Their pH is above 8.3. Under natural conditions, these soils can be recognized by the salt crusts, the numerous areas where nothing grows, the sparse growth of saltgrass, and the presence of such plant indicators as samphire and iodine bush.

The strongly saline-alkali soils are ordinarily not cultivated. If they are, crop growth is almost entirely absent. Puffy brown salt crusts are widespread. Brown or black dissolved organic scum and staining are very common.

Slightly saline soils contain from 0.2 to 0.5 percent of salts. Their pH is below 8.3. In the field it is difficult to tell these soils from those that are free of salts. Salt crusts are rare, and there are few of the salt indicator plants. The natural vegetation may be a mat of lippia, or it may be a mixture of saltgrass and other less salt-tolerant grasses.

When slightly saline soils are cultivated, such crops as cotton and sugar beets may do very well. Moderately salt-tolerant plants show little ill effect from the slight salinity. Crops that tolerate salt poorly are not grown on these soils in the Merced Area. If they were, reduced yields would be expected.

Moderately saline soils contain from 0.5 to 1 percent of salts. Their pH is below 8.3. Most of these soils lie on the San Joaquin River flood plain. Both dark-colored and light-colored salt puffs and crusts may be present. The dark color of some puffs is caused by the generally larger content of dissolved organic matter. Most of the vegetation is saltgrass and alkali heath. Some lippia may be present.

Cotton and sugar beets are cultivated on these soils with some success, but even salt-tolerant crops grow poorly and barren spots appear. Ordinary table salt, or sodium chloride, commonly accumulates along irrigation furrows.

Strongly saline soils contain more than 1 percent of salts. The pH is below 8.3. They generally support a moderate growth of saltgrass. Barren spots, salt crusts, and dark, puffy spots are common. Grain is grown to a limited extent in fields that contain strongly saline areas, but no significant yields are obtained.

If saline or alkali soils that support saltgrass are used only for grazing, fair to good yields of beef are obtained and management is not too difficult. If the presence of salts or alkali reduces the suitability of a soil for crops, reclamation of the soil may be profitable. In many places this means establishing a drainage system to lower the water table, using soil correctives, and using irrigation water generously to dissolve and leach away the excess salts.

When saline soils that do not contain much sodium are leached of their excess salts, they become normal in soil characteristics. Reclamation is possible wherever good drainage can be established and enough water is available to leach away the excess salts (*11*, *25*). If the water table is high, it must be lowered by drainage ditches, tile drains, or drainage pumps. If the soil contains impervious material, such as a hardpan subsoil, the leaching of salts is more difficult. It is necessary to flood the soil repeatedly and drain off the water after it has dissolved part of the salts in the soil.

Reclamation of soils that contain appreciable amounts of adsorbed sodium or alkali is much more difficult, especially if the soils contain considerable clay. The dispersion of the clay when the soils are irrigated seals the surface, and water cannot penetrate to leach out the salts. In addition to draining and flooding, it is necessary to add gypsum, sulfur, or sulfuric acid to replace the adsorbed sodium, improve permeability, and improve the workability after reclamation. If a cemented hardpan or dense clay subsoil is present, reclamation may be impossible because the salts cannot be removed by downward leaching.

Some soils in this Area are relatively easy to reclaim. The Columbia and Temple soils can be reclaimed by proper drainage and leaching. The Burchell, Borden, Dello, Dinuba, Grangeville, Hilmar, Pachappa, and Piper soils require, in addition, soil correctives or cover crops. The Landlow, Madera, Merced, Traver, and Wyman soils can be reclaimed, but with difficulty. They require drainage and leaching, plus both correctives and cover crops. The Fresno, Lewis, Pozo, Rossi, and Waukena soils are very difficult to reclaim. They need drainage, repeated flooding, correctives, and cover crops.

By growing irrigated pasture and rice, which require large quantities of irrigation water, considerable improvement of saline-alkali soils is possible without expensive special reclamation practices. Good drainage is essential, because if the water table rises to within 6 or 7 feet of the surface, salts will again be brought to the surface and will accumulate there. The most successful reclamation in the Area has been accomplished by growing rice in an area southwest of the Merced airport. The so-called "sandy mush" area and some areas east of Stevinson show the results of unsuccessful attempts to grow crops on soils affected by salts.

Irrigation water must be of good quality if reclamation is to be permanently successful. It should not contain salts that will add to the salinity of the soil irrigated. The following standards for classifying irrigation water will help to determine its value for use on soils (*13*) (table 4).

Class I irrigation water ranges from excellent to good. It is suitable for most plants under most conditions.

Class II irrigation water ranges from good to injurious, depending on the crop and other factors. It is probably harmful to the more sensitive crops.

Class III irrigation water ranges from injurious to unsatisfactory. This water is harmful to most crops and is not suitable for use on any but the most salt-tolerant crops. If the characteristics of the water fall within the limits of class 3 in any respect listed in table 4, the water should be considered unsuitable under most conditions.

If the salts present in the water are mostly sulfates, the amount of salts allowable in each class can be raised by 50 percent.

Sodium content as a percentage of bases refers to the amount of sodium as compared to the total amount of soluble bases—sodium, calcium, magnesium, and potassium—when all are expressed in equivalents. If the salt content of the water is low but more than 60 percent sodium, the quality of the water can be improved by dissolving gypsum in it. Only enough gypsum need be added to lower the proportion of sodium to less than 50 percent (*4*).

If the water contains little sodium, but the salt content ranges from 700 to 2,000 parts per million, enough water must be used to maintain leaching through the entire root zone and carry away the salts that might accumulate from the water (*6*). Using too much water should be avoided, however, because it may result in a high water table and because excessive leaching may remove nitrates and other plant nutrients.

Soils of the Merced Area

Soil surveying consists of the examination, classification, and mapping of soils in the field. The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those

TABLE 4.—*Standards for irrigation water*

Characteristic measured	Class I	Class II	Class III
Conductance .... $K \times 10^5$ at 25° C	Less than 100	100 to 300	More than 300.
Total salt content .... parts per million	Less than 700	700 to 2,000	More than 2,000.
Salt content per acre-foot .... tons	Less than 1	1 to 3	More than 3.
Sodium content as a percentage of bases .... percent	Less than 60	60 to 75	More than 75.
Boron content .... parts per million	Less than 0.5	0.5 to 2.0	More than 2.0.

in road or railroad cuts, are studied. Each excavation shows a series of distinct soil layers, or horizons, called collectively the soil profile.

Each horizon of the soil, as well as the parent material beneath the soil, is carefully observed; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. Drainage, both internal and external, and other external features, such as relief or lay of the land, are considered, and the interrelation of soil and vegetation is studied. To supplement the field examinations, many soil samples are sent to the laboratory for detailed physical and chemical analyses.

The reaction of the soil and its content of lime and salts are determined in the field by simple tests. The reaction of the soil is its degree of acidity or alkalinity, expressed as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strongly alkaline reaction. Lime (calcium carbonate) is detected by the use of hydrochloric acid. A soil "containing free lime in sufficient quantity to be detected by the application of dilute hydrochloric acid" is called *calcareous*. *Noncalcareous* means "not containing free lime in sufficient quantity to be so detected." A soil may contain an abundance of available calcium and yet not be calcareous in the foregoing sense.

The soil surveyor makes a map of the county or Area, showing the location of each of the soil types, phases, and miscellaneous land types. The map shows roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

The soils are classified according to their characteristics, with special emphasis on those features that influence their suitability for the growing of crop plants, grasses, and trees. On the basis of these characteristics, soils are grouped into mapping units. The three principal units are the series, the type, and the phase. In some places two or more of these principal units may form such an intricate or mixed pattern that they cannot be clearly shown separately on a small-scale map. Such a combination is mapped as a complex. If the several soils are not regularly geographically associated, but it is for some other reason not practical to separate them, they are mapped together as an undifferentiated group. Areas that have little or no true soil, such as Riverwash or Slate rock land, are classified as miscellaneous land types.

A series consists of soils whose genetic horizons are similar in their important characteristics and arrangement in the soil profile and which developed from a particular kind of parent material. The soils in one series have essentially the same color, texture, structure, and other important internal characteristics, and the same natural drainage conditions and range in relief. The texture of the upper part of the soil may differ within a series. A soil series is usually given the name of a place or geographic feature near which it was first identified. Thus, Delhi, Atwater, and Merced are names of important soil series first recognized in this Area.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus the class name of the soil texture, such as sandy loam, fine sandy loam, loam, silt loam, clay loam, silty clay loam, silty clay, or clay is added to the series name to give the name of the soil type. For example, Hanford sandy loam and Hanford fine sandy loam are soil types within the Hanford series. Except for the texture of the surface soil, the two soil types have nearly the same characteristics.

Within soil types, minor soil differences, such as variations in effective rooting depth, slope, erosion, drainage, and content of salts or alkali, may be of considerable practical importance in farming or other use. On the basis of such differences, soil types are divided into phases. For example, Hanford fine sandy loam, moderately deep and deep over sand, is a phase of the Hanford fine sandy loam type. The slope is indicated for every mapping unit in which slope affects the use. Salts or alkali, poor drainage, erosion, gullies, and channeled areas are indicated where such conditions exist. Soil types and soil phases are the principal mapping units shown on the soil map.

The approximate acreage and proportionate extent of the soils mapped are given in table 5.

TABLE 5.—*Approximate acreage and proportionate extent of soils*

Mapping unit	Area	Extent	Mapping unit	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Alamo clay, 0 to 1 percent slopes	875	0. 1	Bear Creek loam, 0 to 3 percent slopes	1, 618	0. 2
Amador loam, 0 to 8 percent slopes	4, 320	. 7	Bear Creek clay loam, 0 to 3 percent slopes	412	(1)
Amador loam, 8 to 30 percent slopes	1, 803	. 3	Bear Creek soils, 0 to 3 percent slopes	824	. 1
Amador loam, 30 to 45 percent slopes	22	(1)	Borden fine sandy loam, 0 to 3 percent slopes	1, 570	. 2
Anderson gravelly soils, channeled, 0 to 3 percent slopes	456	(1)	Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	59	(1)
Atwater sand, 0 to 3 percent slopes	1, 885	. 3	Burchell silt loam, 0 to 1 percent slopes	1, 966	. 3
Atwater sand, 3 to 8 percent slopes	12, 388	1. 9	Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes	2, 149	. 3
Atwater loamy sand, 0 to 3 percent slopes	6, 600	1. 0	Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes	447	(1)
Atwater loamy sand, 3 to 8 percent slopes	8, 980	1. 4	Burchell silty clay loam, 0 to 1 percent slopes	2, 397	. 4
Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes	1, 646	. 2	Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	2, 492	. 4
Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes	840	. 1	Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	606	(1)
Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes	1, 226	. 2	Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes	693	. 1
Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes	1, 741	. 3			
Auburn rocky silt loam, 3 to 8 percent slopes	1, 268	. 2			

[1] Less than 1/10 of 1 percent.

TABLE 5.—*Approximate acreage and proportionate extent of soils*—Continued

Mapping unit	Area	Extent	Mapping unit	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes	342	(1)	Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes	213	(1)
Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes	712	0. 1	Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes	705	0. 1
Columbia soils, channeled, 0 to 3 percent slopes	2, 765	. 4	Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes	81	(1)
Corning gravelly sandy loam, 0 to 8 percent slopes	1, 344	. 2	Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes	619	(1)
Corning gravelly sandy loam, 8 to 30 percent slopes	1, 658	. 3	Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes	339	(1)
Corning gravelly sandy loam, 8 to 30 percent slopes, eroded	956	. 1	Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes	414	(1)
Corning gravelly sandy loam, 30 to 45 percent slopes, eroded	87	(1)	Grangeville fine sandy loam, 0 to 1 percent slopes	5, 487	. 8
Corning gravelly loam, 0 to 8 percent slopes	5, 128	. 8	Grangeville loam, 0 to 1 percent slopes	3, 373	. 5
Corning gravelly loam, 8 to 30 percent slopes	3, 095	. 5	Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes	2, 030	. 3
Corning gravelly loam, 8 to 30 percent slopes, eroded	1, 676	. 3	Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes	73	(1)
Corning gravelly loam, 30 to 45 percent slopes, eroded	127	(1)	Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes	2, 743	. 4
Corning cobbly loam, 3 to 8 percent slopes	69	(1)	Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes	618	(1)
Corning cobbly loam, 8 to 30 percent slopes	125	(1)	Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied	19	(1)
Daulton rocky silt loam, 3 to 8 percent slopes	116	(1)	Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes	994	. 2
Daulton rocky silt loam, 8 to 30 percent slopes, eroded	118	(1)	Hanford sandy loam, 0 to 1 percent slopes	5, 106	. 8
Delhi sand, 0 to 3 percent slopes	29, 899	4. 5	Hanford gravelly sandy loam, 0 to 1 percent slopes	1, 078	. 2
Delhi sand, 3 to 8 percent slopes	4, 777	. 7	Hanford fine sandy loam, 0 to 1 percent slopes	3, 116	. 5
Delhi sand, 8 to 15 percent slopes	424	(1)	Hanford fine sandy loam, channeled, 0 to 8 percent slopes	671	. 1
Delhi loamy sand, 0 to 3 percent slopes	5, 336	. 8	Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes	1, 295	. 2
Delhi loamy sand, 3 to 8 percent slopes	878	. 1	Hilmar loamy sand, 0 to 3 percent slopes	14, 142	2. 1
Delhi loamy fine sand, 0 to 3 percent slopes	422	(1)	Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes	12, 185	1. 8
Delhi loamy fine sand, 3 to 8 percent slopes	150	(1)	Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	1, 083	. 2
Delhi sand, silty substratum, 0 to 3 percent slopes	3, 822	. 6	Hilmar sand, 0 to 3 percent slopes	4, 995	. 8
Delhi sand, silty substratum, 3 to 8 percent slopes	149	(1)	Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes	3, 482	. 5
Delhi loamy sand, silty substratum, 0 to 3 percent slopes	3, 815	. 6	Hilmar sand, poorly drained, 0 to 1 percent slopes	310	(1)
Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes	3, 655	. 6	Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes	627	(1)
Dello sand, 0 to 1 percent slopes	1, 792	. 3	Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes	100	(1)
Dello sand, slightly saline-alkali, 0 to 1 percent slopes	807	. 1	Honcut silt loam, 0 to 1 percent slopes	9, 919	1. 5
Dello sand, poorly drained, 0 to 1 percent slopes	119	(1)	Honcut silt loam, deep over hardpan, 0 to 1 percent slopes	758	. 1
Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	390	(1)	Honcut fine sandy loam, 0 to 1 percent slopes	906	. 1
Dello loamy fine sand, 0 to 1 percent slopes	373	(1)	Honcut gravelly sandy loam, 0 to 1 percent slopes	454	(1)
Dinuba sandy loam, 0 to 1 percent slopes	3, 186	. 5	Honcut silty clay loam, 0 to 1 percent slopes	1, 816	. 3
Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes	2, 627	. 4	Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes	117	(1)
Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes	264	(1)	Honcut silty clay loam, channeled, 0 to 8 percent slopes	258	(1)
Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes	264	(1)	Hopeton clay loam, 0 to 3 percent slopes	253	(1)
Dune land, 0 to 3 percent slopes	576	(1)	Hopeton clay loam, 3 to 8 percent slopes	750	. 1
Dune land, 3 to 8 percent slopes	1, 193	. 2	Hopeton clay loam, 8 to 15 percent slopes	626	(1)
Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes	2, 463	. 4	Hopeton gravelly clay loam, 0 to 8 percent slopes	1, 226	. 2
Foster fine sandy loam, 0 to 1 percent slopes	352	(1)	Hopeton clay, 0 to 8 percent slopes	1, 633	. 2
Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	830	. 1	Hornitos fine sandy loam, 3 to 8 percent slopes	1, 681	. 3
Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes	674	. 1	Hornitos fine sandy loam, 8 to 30 percent slopes	1, 314	. 2
Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes	260	(1)	Hornitos fine sandy loam, 30 to 45 percent slopes	18	(1)
Foster gravelly fine sandy loam, 0 to 1 percent slopes	137	(1)	Hornitos gravelly fine sandy loam, 0 to 8 percent slopes	2, 439	. 4
Fresno loam, slightly saline-alkali, 0 to 1 percent slopes	11, 666	1. 8			
Fresno loam, moderately saline-alkali, 0 to 1 percent slopes	16, 522	2. 5			
Fresno loam, strongly saline-alkali, 0 to 1 percent slopes	12, 694	1. 9			

[1] Less than 1/10 of 1 percent.

TABLE 5.—*Approximate acreage and proportionate extent of soils*—Continued

Mapping unit	Area	Extent
	Acres	*Percent*
Hornitos gravelly fine sandy loam, 8 to 30 percent slopes	1,486	0.2
Keyes gravelly loam, 0 to 8 percent slopes	2,416	.4
Keyes gravelly loam, 8 to 15 percent slopes	78	(1)
Keyes gravelly clay loam, 0 to 8 percent slopes	2,098	.3
Keyes-Pentz gravelly loams, 0 to 8 percent slopes	2,569	.4
Landlow silty clay loam, 0 to 1 percent slopes	7,078	1.1
Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	5,887	.9
Landlow silt loam, 0 to 1 percent slopes	232	(1)
Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes	528	(1)
Landlow clay, 0 to 1 percent slopes	5,059	.8
Landlow clay, slightly saline-alkali, 0 to 1 percent slopes	3,820	.6
Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	5,792	.9
Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	3,977	.6
Lewis loam, strongly saline-alkali, 0 to 1 percent slopes	1,063	.2
Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	6,951	1.1
Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	7,727	1.2
Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes	2,564	.4
Lewis clay, slightly saline-alkali, 0 to 1 percent slopes	1,189	.2
Lewis clay, moderately saline-alkali, 0 to 1 percent slopes	5,409	.8
Madera sandy loam, 0 to 3 percent slopes	3,099	.5
Madera sandy loam, 3 to 8 percent slopes	1,343	.2
Madera fine sandy loam, 0 to 3 percent slopes	3,241	.5
Madera loam, 0 to 1 percent slopes	3,604	.5
Madera loam, slightly saline-alkali, 0 to 1 percent slopes	157	(1)
Marguerite loam, 0 to 1 percent slopes	1,745	.3
Marguerite silty clay loam, 0 to 1 percent slopes	1,220	.2
Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes	1,960	.3
Merced clay loam, slightly saline, 0 to 1 percent slopes	4,115	.6
Merced clay loam, moderately saline, 0 to 1 percent slopes	2,659	.4
Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes	3,723	.6
Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes	60	(1)
Merced clay, slightly saline, 0 to 1 percent slopes	1,076	.2
Merced clay, moderately saline, 0 to 1 percent slopes	136	(1)
Montpellier coarse sandy loam, 0 to 3 percent slopes	81	(1)
Montpellier coarse sandy loam, 3 to 8 percent slopes	1,726	.3
Montpellier coarse sandy loam, 8 to 15 percent slopes	1,546	.2
Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded	1,554	.2
Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded	3,200	.5
Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded	159	(1)
Pachappa sandy loam, 0 to 1 percent slopes	3,007	.5
Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	1,330	.2
Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes	1,769	.3
Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	3,432	.5

Mapping unit	Area	Extent
	Acres	*Percent*
Pachappa fine sandy loam, 0 to 1 percent slopes	3,237	0.5
Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	1,687	.3
Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes	510	(1)
Pentz loam, 0 to 8 percent slopes	1,904	.3
Pentz loam, 8 to 30 percent slopes	1,077	.2
Pentz loam, 30 to 75 percent slopes	121	(1)
Pentz gravelly loam, 0 to 8 percent slopes	9,139	1.4
Pentz gravelly loam, 8 to 30 percent slopes	5,791	.9
Pentz clay loam, 0 to 8 percent slopes	1,384	.2
Pentz clay loam, 8 to 30 percent slopes	377	(1)
Peters clay, 0 to 8 percent slopes	1,128	.2
Peters clay, 8 to 15 percent slopes	196	(1)
Peters cobbly clay, 0 to 8 percent slopes	1,694	.3
Peters cobbly clay, 8 to 30 percent slopes	934	.1
Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	363	(1)
Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes	421	(1)
Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	24	(1)
Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes	206	(1)
Pits	60	(1)
Porterville clay, 0 to 3 percent slopes	5,529	.8
Porterville clay, 3 to 8 percent slopes	156	(1)
Pozo clay loam, 0 to 1 percent slopes	595	(1)
Pozo clay loam, slightly saline, 0 to 1 percent slopes	1,241	.2
Pozo clay loam, moderately saline, 0 to 1 percent slopes	229	(1)
Raynor clay, 0 to 3 percent slopes	3,600	.5
Raynor clay, 3 to 8 percent slopes	1,791	.3
Raynor clay, 8 to 15 percent slopes	185	(1)
Raynor cobbly clay, 0 to 3 percent slopes	3,120	.5
Raynor cobbly clay, 3 to 8 percent slopes	1,750	.3
Raynor cobbly clay, 8 to 15 percent slopes	491	(1)
Redding gravelly loam, 0 to 8 percent slopes	35,531	5.4
Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes	107	(1)
Redding gravelly loam, 8 to 30 percent slopes	2,343	.4
Redding cobbly loam, 0 to 8 percent slopes	2,147	.3
Riverwash	2,855	.4
Rocklin loam, 0 to 3 percent slopes	1,249	.2
Rocklin loam, 3 to 8 percent slopes	5,974	.9
Rocklin loam, 8 to 15 percent slopes	36	(1)
Rocklin sandy loam, 0 to 3 percent slopes	273	(1)
Rocklin sandy loam, 3 to 8 percent slopes	1,996	.3
Rocklin sandy loam, 3 to 8 percent slopes, eroded	392	(1)
Rocklin sandy loam, 8 to 15 percent slopes, eroded	156	(1)
Rossi clay, moderately saline-alkali, 0 to 1 percent slopes	2,232	.3
Rossi clay, strongly saline-akali, 0 to 1 percent slopes	3,306	.5
Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	26	(1)
Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes	2,412	.4
Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes	5,390	.8
Ryer silt loam, 0 to 3 percent slopes	1,576	.2
Ryer clay loam, 0 to 3 percent clopes	1,315	.2
Ryer clay loam, 3 to 8 percent slopes	119	(1)
Sandstone rock land	1,371	.2
San Joaquin sandy loam, 0 to 3 percent slopes	6,685	1.0
San Joaquin sandy loam, 3 to 8 percent slopes	3,607	.5
San Joaquin loam, 0 to 3 percent slopes	5,635	.9
San Joaquin loam, 3 to 8 percent slopes	1,485	.2

[1] Less than 1/10 of 1 percent.

TABLE 5.—*Approximate acreage and proportionate extent of soils*—Continued

Mapping unit	Area	Extent	Mapping unit	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
San Joaquin-Alamo complex, 0 to 3 percent slopes	5, 135	0. 8	Waukena loam, slightly saline-alkali, 0 to 1 percent slopes	296	(1)
Schist rock land	40	(1)	Waukena loam, moderately saline-alkali, 0 to 1 percent slopes	295	(1)
Sesame rocky loam, 3 to 8 percent slopes	383	(1)	Waukena loam, strongly saline-alkali, 0 to 1 percent slopes	1, 660	0. 3
Sesame rocky loam, 8 to 30 percent slopes	144	(1)	Whiterock rocky silt loam, 3 to 8 percent slopes	578	(1)
Seville clay, 0 to 3 percent slopes	937	. 1	Whiterock rocky silt loam, 3 to 8 percent slopes, eroded	73	(1)
Seville clay, 3 to 8 percent slopes	112	(1)	Whiterock rocky silt loam, 8 to 30 percent slopes	1, 953	. 3
Slate rock land	92	(1)	Whiterock rocky silt loam, 8 to 30 percent slopes, eroded	429	(1)
Slickens	87	(1)	Whitney fine sandy loam, 3 to 8 percent slopes	3, 142	. 5
Snelling sandy loam, 0 to 3 percent slopes	5, 204	. 8	Whitney fine sandy loam, 3 to 8 percent slopes, eroded	149	(1)
Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes	656	(1)	Whitney fine sandy loam, 8 to 15 percent slopes	3, 433	. 5
Snelling sandy loam, 3 to 8 percent slopes	3, 165	. 5	Whitney fine sandy loam, 8 to 15 percent slopes, eroded	930	. 1
Snelling sandy loam, 3 to 8 percent slopes, eroded	571	(1)	Whitney fine sandy loam, 15 to 30 percent slopes, eroded	4, 898	. 7
Snelling sandy loam, 8 to 15 percent slopes	868	. 1	Whitney fine sandy loam, 30 to 45 percent slopes, eroded	280	(1)
Snelling sandy loam, 8 to 15 percent slopes, eroded	857	. 1	Whitney sandy loam, 3 to 8 percent slopes	687	. 1
Snelling sandy loam, 15 to 30 percent slopes, eroded	622	(1)	Whitney sandy loam, 8 to 15 percent slopes	144	(1)
Tailings	5, 265	. 8	Whitney sandy loam, 8 to 15 percent slopes, eroded	90	(1)
Temple loam, 0 to 1 percent slopes	106	(1)	Whitney sandy loam, 15 to 30 percent slopes, eroded	787	. 1
Temple loam, slightly saline, 0 to 1 percent slopes	2, 203	. 3	Whitney and Rocklin soils, 3 to 8 percent slopes, eroded	6, 080	. 9
Temple clay loam, 0 to 1 percent slopes	306	(1)	Whitney and Rocklin soils, 8 to 15 percent slopes, eroded	1, 488	. 2
Temple clay loam, slightly saline, 0 to 1 percent slopes	2, 516	. 4	Wyman loam, 0 to 3 percent slopes	3, 777	. 6
Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes	450	(1)	Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes	536	(1)
Terrace escarpments	1, 426	. 2	Wyman loam, deep over hardpan, 0 to 3 percent slopes	7, 513	1. 1
Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	3, 373	. 5	Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	1, 822	. 3
Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	6, 788	1. 0	Wyman clay loam, 0 to 3 percent slopes	4, 953	. 8
Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	2, 891	. 4	Wyman clay loam, deep over hardpan, 0 to 1 percent slopes	7, 243	1. 1
Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes	65	(1)	Yokohl loam, 0 to 3 percent slopes	4, 273	. 6
Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes	123	(1)	Yokohl loam, 3 to 8 percent slopes	318	(1)
Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes	434	(1)	Yokohl clay loam, 0 to 3 percent slopes	10, 023	1. 5
Tuff rock land	21	(1)	Yokohl clay, 0 to 3 percent slopes	534	(1)
Tujunga sand, 0 to 3 percent slopes	1, 634	. 2	Yolo loam, 0 to 1 percent slopes	2, 390	. 4
Tujunga sand, channeled, 0 to 8 percent slopes	596	(1)	Yolo loam, deep over hardpan, 0 to 1 percent slopes	252	(1)
Tujunga gravelly sand, channeled, 0 to 8 percent slopes	649	(1)	Water	4, 110	. 6
Tujunga loamy sand, 0 to 3 percent slopes	1, 157	. 2	Intermittently under water	6, 566	1. 0
Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	522	(1)	Total	659, 840	--------
Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	1, 024	. 2			
Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	510	(1)			

[1] Less than 1/10 of 1 percent.

Alamo Series

The Alamo soils lie in depressions on old, gently undulating terraces or alluvial fans. The parent material is loamy alluvium derived from granitic rocks and from soils formed on such rocks. Associated with the Alamo soils, in many places in a complex pattern, are the well-drained San Joaquin and Madera soils.

The Alamo soils are poorly drained. In spring, water sometimes stands in the depressions, but it is gone by midsummer. The vegetation is a sparse cover of annual grasses, herbs, and weeds.

The outstanding characteristics of the Alamo soils are a clay profile and a strongly cemented, very slowly permeable, alkaline, calcareous hardpan. The surface soil is gray or dark gray when dry, very dark gray when moist, and slightly acid to neutral. The subsoil is gray when dry, dark gray when moist, and neutral to mildly alkaline. The depth to the hardpan is 12 to 24 inches. The hardpan is 1½ to 12 inches or more in thickness. At its lower boundary it grades into compact sediments and finally into stratified loamy sediments.

Alamo clay, 0 to 1 percent slopes (AaA).—This soil stands out as dark-colored clay in depressions within areas

of the lighter colored San Joaquin and Madera soils. Most commonly the areas are small, but some are 30 to 40 acres in size.

Representative profile:

1. The surface soil, to a depth of 6 to 8 inches, is gray or dark-gray, slightly acid to neutral clay. It is very sticky when wet and dries very hard, forming a very coarse, blocky structure with large cracks. Secondary cracking of the immediate surface produces a thin layer of fine granular material. When moist, the surface has a dispersed, shiny appearance.
2. The subsoil, to a depth of 12 to 18 inches, is dense, gray, neutral to slightly alkaline clay that is very sticky when wet and very hard when dry. It has coarse, blocky structure when dry, but swells and runs together when wet, taking on a massive appearance. The lower subsoil, for a few inches above the hardpan, is mottled because it is often saturated by water perched on the hardpan below. Disseminated or segregated lime is present in some places. The lower boundary is very abrupt.
3. The hardpan, strongly cemented with iron and silica, ranges in thickness from 1½ to 12 inches or more. It is pale brown to reddish brown in color and has platy or laminar structure. There are seams of lime throughout, mostly thin but in some places very thick. The surface and seams of the pan may be coated with purplish-black stains, probably manganese oxides. The hardpan can be penetrated only by a pick or steel bar and can be broken only by very powerful subsoiling equipment. The transition to the parent material below is gradual.
4. Below the hardpan are weakly cemented, stratified, calcareous granitic sediments of sandy loam to sandy clay loam texture; this layer becomes softer and less cemented with increasing depth.

This soil is poorly drained and is often ponded in winter and spring. Above the hardpan it is slowly permeable. The hardpan is almost impermeable to roots, water, and air. The total available water holding capacity is low. Natural fertility is low—phosphorus and nitrogen in particular are deficient. There is no erosion hazard.

This soil is hard to work because it is so high in clay. It forms into hard clods when it is dry, and it is very sticky when wet. It is closely associated with sandier soils and is usually cultivated along with the drier, higher areas surrounding it. Consequently, it is usually worked when wet, and implements often get stuck in the mud. In wet years, these depressions are ponded and the crops are drowned out. Yields may be fairly good in dry years when the surrounding sandy soils yield very little. The principal crop is grain grown without irrigation; the soil is fallowed in alternate years. (Capability unit IIIw-5; Storie index rating 12)

Amador Series

The Amador soils lie in scattered spots along the edge of the Sierra Nevada foothills where rhyolitic rock is exposed. They are associated mainly with soils of the Hornitos series.

These soils are well drained to somewhat excessively drained, but in places they are mottled, apparently because of restricted drainage. The parent rock is a light yellowish-brown sedimentary rock derived largely from rhyolitic tuff and pumice. The relief generally is undulating to gently rolling, and the surface has a pronounced mound microrelief. The mounds range from 2 to 5 feet in height. The vegetative cover is very sparse and consists mainly of alfileria and small bulb plants.

The outstanding characteristics of the Amador soils are a shallow to very shallow profile, very pale brown color, and strongly acid to very strongly acid reaction. Loam textures predominate. There is considerable fine gravel in places.

Amador loam, 0 to 8 percent slopes (AbB).—This soil occurs north of Snelling and along a line extending southeast from Merced Falls to Dutchman Creek, in the southeastern part of Merced County.

Representative profile:

1. The surface soil is very pale brown loam that has weak, blocky to platy structure. This layer is hard when dry and friable when moist. White quartz gravel, ¼ to 1 inch in diameter, is present on the surface and throughout this layer. The depth ranges from 14 to 18 inches in the center of the mounds and becomes progressively less toward the edges. There is no soil at all in many of the areas between the mounds. The transition from this layer to the parent rock is abrupt.
2. The parent material is light yellowish-brown sedimentary rock, composed principally of rhyolitic tuff and pumice. When exposed to the air, as it is in many of the areas between mounds, the rock is very light yellowish gray, and it sloughs off in small irregular fragments ¼ to ½ inch in diameter.

This soil is well drained and strongly acid. It has very low water-holding capacity. It is low in organic matter. The surface soil is moderately permeable. It is faintly mottled just above the rhyolitic parent rock. This soil is very low in fertility. It is deficient in nitrogen, phosphorus, and potassium, as well as some of the other plant nutrients. In many locations where this soil is associated with the Redding soils, it has considerable gravel on the surface. In some areas the entire profile is gravelly. Runoff is medium. The erosion hazard is moderate.

Small areas that have fine sandy loam texture are included in this unit.

This soil is not cultivated. It supports a sparse cover composed principally of alfileria and a few annual grasses. The chief agricultural use is grazing of beef cattle. (Capability unit VIIe-9; Storie index rating 9)

Amador loam, 8 to 30 percent slopes (AbD).—This well drained to somewhat excessively drained, strongly acid soil lies along the eastern edge of the Merced Area. The surface layer is slightly shallower than that of Amador loam, 0 to 8 percent slopes, and more of the rhyolitic rock is exposed between the mounds. The surface is distinctly hummocky, and the slope is mostly between 10 and 20 percent. Because of the very shallow profile, the bare areas between the mounds, and the sparse vegetative cover, surface runoff is rapid and the soil is highly susceptible to erosion.

This soil is used entirely for winter and spring range for beef cattle. This is the only agricultural use to which it is suited. (Capability unit VIIe-9; Storie index rating 7)

Amador loam, 30 to 45 percent slopes (AbE).—This excessively drained soil is similar to Amador loam, 0 to 8 percent slopes, but it is slightly shallower and has steeper slopes. Surface runoff is very rapid. The erosion hazard is severe.

This soil is used for range for beef cattle. (Capability unit VIIe-9; Storie index rating 4)

Anderson Series

The Anderson soils developed in gravelly alluvium deposited beside minor, intermittent drainageways. They are associated with the Redding and Corning soils of the high terraces and with the Pentz, Peters, and Raynor soils of the uplands. The narrow flood plains on which the Anderson soils lie are subject to infrequent flash floods caused by local heavy rains. They are cut by shallow, braided channels.

Drainage is generally good, but in some spots it is poor because of unrelated, dense substrata below the gravel layers. The vegetative cover is mainly alfileria and annual grasses.

The parent material of the Anderson soils was derived from the nearby soils and in many places resembles these soils in texture, content of gravel, and color. The alluvium is considerably stratified. In spots the subsoil contains slightly more clay than the surface soil.

Anderson gravelly soils, channeled, 0 to 3 percent slopes (AcA).—These undifferentiated, gravelly alluvial soils occur in narrow, very gently sloping bands. They formed from material derived from the associated Corning and Redding soils of the high terraces, and the Peters, Pentz, Raynor, Exchequer, and Auburn soils of the uplands.

Representative profile:

1. The surface soil, to a depth of 10 to 20 inches, is slightly acid, essentially massive, gravelly sandy loam, gravelly loam, or cobbly loam. In most places it is overlain by weak platy, recent, sandy deposits an inch or more thick. The color of the surface soil is dominantly brownish, but it ranges from light brown to light reddish brown. This layer is low in organic matter and plant nutrients. Water penetrates rapidly. The transition to the horizon below is gradual.
2. The subsoil is brown to reddish brown, slightly acid, heavy gravelly sandy loam or heavy gravelly loam. In places it contains slightly more clay than the surface soil. When dry it is usually hard and massive. The large amount of gravel either masks or restricts the development of structure. Layers of cobblestones and coarse gravel are common, and the size and quantity of this coarse material increases with depth. The subsoil ranges in thickness from 10 to 20 inches. The transition to the next layer is gradual.
3. This layer consists of loose, brown to reddish-brown, slightly acid to neutral, massive, very gravelly or cobbly sandy loam. It ranges in thickness from 1 foot to several feet.

Numerous small narrow areas of shallow soil are included in this unit. In many places the alluvium rests directly on unrelated hard rock or hardpan at a depth of 3 to 4 feet.

Most of the acreage is well drained. A few areas underlain by unrelated rock or hardpan are poorly drained. Permeability is rapid, water-holding capacity is low, and surface runoff is very slow. The erosion hazard is slight. Fertility is moderate.

These soils tend to be droughty because they have a low water-holding capacity, and they dry out quickly in summer. Grazing for beef cattle is the principal agricultural use. The cobblestones and gravel, the limited area, and the flood hazard make cultivation difficult.

New material is deposited on these soils every year. This benefits the natural grass vegetation. Forage is better than on the nearby soils from which these soils were derived, but it is less abundant than on the Bear Creek or Hanford soils.

The gravel is gold bearing. It has been worked for gold in a few places where the water supply was sufficient. (Capability unit VIIe-3; Storie index rating 17)

Atwater Series

The Atwater soils occur near Atwater, Winton, Cressey, Livingston, and Ballico, on a moderately old, undulating alluvial fan of the Merced River. The undulations are largely the result of wind action.

These soils developed from sandy, granitic alluvium deposited at the same time as the parent material of the Snelling soils. The Atwater soils, however, are more exposed to the prevailing winds, and erosion and deposition have somewhat retarded their development. Compared to other soils that formed from similar parent material, the Atwater are more strongly weathered than the Delhi and less weathered than the Snelling. The Greenfield soils are probably most like the Atwater, but they have not been modified by wind and usually are slightly finer textured, especially in the surface soil.

Except in the lowest of the depressions and along the edge of the Area, the Atwater soils are well drained. The vegetative cover consists of annual grasses and scattered oaks.

These soils are characterized by a coarse-textured surface soil—generally sand or loamy sand—a deep profile, and a pale-brown subsoil. The surface soil is pale brown or light grayish brown, because of its high content of quartz and feldspar grains and its very low content of organic matter. In many places the subsoil consists of lenses of heavy sandy loam or sandy clay loam at a depth of 2 to 4 feet. Both surface soil and subsoil are about neutral in reaction.

Atwater sand, 0 to 3 percent slopes (AnA).—This soil lies near Atwater, Winton, Livingston, Cressey, and Ballico, but mainly south of the Merced River. It developed on gently undulating, wind-modified old alluvial fans and valley fill of the Merced River. It is on low terraces at the same altitude as the Snelling soils and slightly higher than the Delhi soils.

Representative profile:

1. The surface soil, to a depth of 12 to 40 inches, is pale-brown to light-brown sand. It is very low in organic matter. The reaction is very slightly acid to neutral.
2. The subsoil is pale-brown to light reddish-brown, slightly hard, massive loam to light sandy clay loam that becomes slightly plastic when wet. The reaction is neutral to very slightly acid. The thickness varies but is generally about 12 inches. The transition to the layer below is gradual.
3. The material below the subsoil is light-brown, neutral to very slightly acid loam or sandy loam that becomes coarser with increasing depth. The thickness of this layer ranges from 1 foot to several feet. In some areas, at a depth of 6 to 10 feet, this layer rests unconformably on an iron-and-silica-cemented hardpan similar to that in the San Joaquin soils.

Natural drainage is good. Permeability is very rapid in the surface soil and moderate in the subsoil. The available water holding capacity is low. The fertility is moderate. Runoff is very slow. There is little or no hazard of water erosion but a severe hazard of wind erosion.

This soil is well suited to irrigated grapes, orchard crops, sweetpotatoes, and deep-rooted crops. Most areas have been leveled. A very small percentage, probably

less than 10 percent, is idle. Yields of fruit are as good as those from any other soil of the Area. Alfalfa does well, but, because of the wind hazard, considerable care is necessary in planting the crop. When alfalfa is properly managed, yields are comparable to the yields from Honcut and Wyman soils. South of the Southern Pacific tracks, sweetpotatoes are grown.

This soil is easy to till. The sandy surface layer permits the use of spraying machinery during the wet winter months without puddling or compacting of the soil. (Capability unit IIIe-4; Storie index rating 50)

Atwater sand, 3 to 8 percent slopes (AnB).—This soil is similar to Atwater sand, 0 to 3 percent slopes, but its surface has been more affected by wind. The relief is undulating; low mounds are oriented in a northwest-southeast direction. Runoff is slow. Some of the largest areas of this soil are southwest of Atwater.

All of this soil is or has been cultivated. Between 10 and 20 percent is now idle. Orchard crops, sweetpotatoes, and grapes are the chief crops.

Management needs are similar to those of Atwater sand, 0 to 3 percent slopes, except that more care in irrigation is required to control erosion. The soil is irrigated in contour checks. The water is brought to the top of the rises in concrete pipes. Some erosion results from irrigation. Tillage is easy. Nitrogen fertilizers are used. (Capability unit IIIe-4; Storie index rating 47)

Atwater loamy sand, 0 to 3 percent slopes (AfA).—About 10 square miles of this soil lies near Atwater, Winton, and Cressey. Near Livingston is a small area in which the transition from the surface soil to the subsoil is gradual, color and texture changes are not distinct, and the subsoil contains only slightly more clay than the surface layer. East of the Fruitland station on the Southern Pacific Railroad is an area in which the subsoil is hard sandy clay loam; this variation of the Atwater soil grades into the Snelling soils toward the northeast.

All of this soil is cultivated. It is well suited to irrigated sweetpotatoes, alfalfa, peaches, apricots, grapes, and almonds. Practically all of it has been leveled and is being intensively used. The water-holding capacity is medium. The hazard of wind erosion is moderate.

The prevailing management is similar to that of Atwater sand, 0 to 3 percent slopes. Yields are comparable with those of the Honcut and Wyman soils. In some places yields of fruit are better.

Many orchards are basin listed to prevent blowing and to distribute the water evenly. Special care is needed to control wind erosion when planting alfalfa and sweetpotatoes. (Capability unit IIe-4; Storie index rating 73)

Atwater loamy sand, 3 to 8 percent slopes (AfB).—Except for its slightly steeper and more undulating slopes, this soil is similar to Atwater loamy sand, 0 to 3 percent slopes. Some of the largest areas are northeast of Winton. Surface runoff is slow.

This soil is well suited to irrigation. Nearly all of it is cultivated and irrigated. It is managed in about the same way as Atwater sand, 0 to 3 percent slopes.

In places the surface soil is eroded. Ordinary irrigation checks tend to break easily, and the soil erodes readily. The contour check method of irrigating pasture and alfalfa reduces water erosion and also helps prevent wind erosion. (Capability unit IIe-4; Storie index rating 69)

Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes (AkA).—This imperfectly drained soil occupies slight depressions that range from 5 to 30 acres in size and lie within areas of well-drained Atwater soils. It receives large amounts of percolation water from these higher lying soils. As a result, its subsoil is faintly mottled and grayer than the corresponding layers in the well-drained soils. The drainage problem has been aggravated by the 3 to 5 feet of irrigation water that is applied during the growing season to crops on nearby fields.

Almost all of this soil is cultivated. It is managed in much the same way as the well-drained Atwater soils, but yields are lower in many areas. Irrigated pasture, alfalfa, and grapevines are not affected to any great extent by the imperfect drainage, but orchard trees are. Drainage can be greatly improved by the use of drainage ditches or pumps. (Capability unit IIIw-4; Storie index rating 65)

Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes (AgA).—This soil is similar to Atwater loamy sand, 0 to 3 percent slopes, except that it is underlain, at a depth of 3½ to 5 feet, by an iron-silica cemented hardpan like that underlying the San Joaquin soils. The transition to this hardpan is abrupt. This soil is near the edge of the higher parts of the terrace that extends eastward from Cressey. A few areas are near Winton, but there is very little of this soil in the triangle between Winton, Atwater, and Cressey. The parent material was granitic alluvium and was deposited by either wind or water over the older hardpan soil.

About 10 percent of this soil is used for pasture and 10 percent is idle; the rest is under irrigation. The soil is not well suited to orchard trees, because irrigation tends to drown the roots. Both table grapes and wine grapes do very well. Alfalfa, sweetpotatoes, and some truck crops are also well suited.

Management needs are similar to those of the other well-drained Atwater soils. Irrigation must be handled with more care, however, using shorter runs, less water, and a larger head than is used on the deeper soils that have no hardpan. (Capability unit IIIe-4; Storie index rating 54)

Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes (AdA).—This mottled variant of the Atwater series occurs in spots or narrow bands 2 to 30 acres in size, next to areas of San Joaquin soils or in depressions within the main bodies of Atwater soils. The naturally poor drainage has been made worse by irrigation of nearby areas.

The subsoil is mottled light grayish-brown to light-gray, neutral to mildly alkaline sandy loam. It rests directly on the hardpan at a depth of 3½ to 5 feet.

Most of this soil is in irrigated pasture or is idle. It is not well suited to orchard trees. It is best suited to shallow-rooted crops. Yields of grapes and sweetpotatoes are low. A few small areas that are too wet for cultivation support willows, reeds, and water-loving plants.

Drainage is the chief problem, but, with careful management, yields from irrigated pasture are satisfactory. The irrigation districts are helping to improve the drainage

by installing pumps to control the water table. (Capability unit IVw-4; Storie index rating 48)

Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes (AgB).—This soil is similar to Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes, but it has stronger slopes and a few drainage channels. Some of the largest areas are located near Castle Field air force base and northeast of Winton, several miles south of the Merced River. The hardpan is at a depth of 3½ to 4 feet. Surface runoff is slow.

This soil is droughty. Wind erosion at seeding time makes it difficult to get a crop started. Water erosion is a hazard in irrigated areas.

Much of this soil is used for barley. The barley is irrigated where water is available, but a large percentage is grown without irrigation. Dryfarmed barley is cropped every other year, and the stubble is not broken until the fall of the following year. Irrigated barley is grown in a rotation with milo.

Nitrogen and phosphorus fertilizers are used. The soil is pre-irrigated for grain, then usually not irrigated again until just before the grain begins to head out. Some small areas near Cressey are in irrigated permanent pasture. (Capability unit IIIe-4; Storie index rating 51)

Auburn Series

The Auburn soils formed from material weathered in place from basic igneous rocks, locally metamorphosed into greenstone. These soils are well drained. They have weakly developed profiles 16 to 30 inches deep.

Auburn soils occur in a small area along the eastern border of Merced County, principally in association with the steeper and shallower Exchequer soils. They have outcrops of bedrock but fewer than the Exchequer soils. The vegetative cover consists of annual grasses and herbs.

Some areas of these soils were formerly used for dry-farmed grain, but now the entire acreage is used for range.

Auburn rocky silt loam, 3 to 8 percent slopes (ArB).—This undulating soil is of small extent. It occupies areas of nearly treeless grassland below the steeper and more dissected areas of Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes, and next to some of the more gently sloping areas of Schist rock land. The profile is predominantly less than 20 inches deep over bedrock. Some places have numerous small outcrops of rock.

Representative profile:

1. The surface soil, to a depth of 5 or 6 inches, is brownish silt loam that has weak, granular structure when moist but is essentially massive when dry. This layer is friable when moist and hard when dry. The reaction is medium acid to slightly acid. The organic-matter content is moderately low. There are numerous very fine pores.
2. The upper subsoil, to a depth of about 10 inches, is reddish-brown, hard, light silty clay loam that has weak, subangular blocky structure. The reaction is slightly acid. The pores are somewhat larger and more numerous than in the surface soil.
3. The lower subsoil, to a depth of 16 to 18 inches, is stronger reddish-brown, hard, light silty clay loam that has weak, angular blocky structure. The reaction is slightly acid. The pores are fewer but larger than in the surface soil.
4. The substratum is slightly altered greenstone. Reddish-brown soil material is mixed with rock fragments in the upper part of this layer, but at a depth of a few more inches the rock is little altered. Generally, the rock is tilted at a high angle. It varies in hardness and compaction within short distances.

A few areas of clay soil are included. The clay occurs in spots ranging from 2 to 5 acres in size, except for one tract of about 50 acres in the extreme northeastern part of the Area.

This soil is well drained and moderately permeable. Its water-holding capacity is low. Runoff is medium. There is a slight hazard of water erosion. Fertility is low.

Part of this soil was cultivated at one time, but the many rock outcrops caused considerable difficulty in tillage. All of the soil is now in winter and spring range for beef cattle. (Capability unit VIIe-3; Storie index rating 23)

Bear Creek Series

The Bear Creek soils occupy narrow alluvial fans composed of material eroded from the nearby Redding, Corning, Pentz, Peters, Raynor, and Amador soils. They are slightly gravelly or cobbly, and they are underlain at a depth of 3 to 5 feet by a dense, unrelated bedrock substratum. Drainage is imperfect, partly because of the dense substratum and partly because nearby streams and runoff from other soils tend to build up a perched water table.

The Bear Creek soils are similar to the Anderson soils, except that they are dark colored and less gravelly. The dark color is due partly to the imperfect drainage and partly to the dark color of the parent material.

Yields of the common grasses, such as alfileria, soft chess, foxtail fescue, and wild oats, are considerably better than on the soils of the nearby terraces.

Bear Creek loam, 0 to 3 percent slopes (BcA).—Areas of this imperfectly drained soil lie along Dry Creek and along some minor channels that drain into Owens and Mariposa Creeks.

Representative profile:

1. The surface soil, to a depth of 8 to 20 inches, is dark-gray, slightly acid to neutral, friable loam. It is massive to weakly granular. The moderately low organic-matter content is higher than that of the terrace and upland soils from which this soil was derived. In most places this layer is slightly gravelly; the size and amount of gravel varies considerably within short distances. There are many roots and insect holes. The transition to the layer below is fairly distinct.
2. The upper part of the subsoil is grayish-brown, light sandy clay loam or clay loam mottled with strong brown. The concentration of mottles increases with depth. The structure is weak to moderate blocky. Few roots penetrate deeply into this layer. The lower part of the subsoil is distinctly grayer and is mottled with yellowish brown. This layer extends to a depth of 3 to 5 feet and has an abrupt lower boundary.
3. The substratum is grayish-brown and bluish-gray, softly consolidated, tuffaceous, sedimentary material, unrelated to the alluvial material above.

Permeability is moderate in the surface soil and slow in the subsoil. The water-holding capacity is moderate. Surface runoff is slow; the soil is flooded at times. The erosion hazard is slight.

This soil is mostly in grass cover. Most areas are best used for range, because they are channeled by intermittent streams and are subject to overflow during rainy weather. Shallow-rooted crops, such as clover and some

irrigated pasture grasses, are best suited, but dryfarmed barley does well. (Capability unit IIIw-2; Storie index rating 53)

Bear Creek clay loam, 0 to 3 percent slopes (BaA).—Except for its finer texture, this soil is similar to Bear Creek loam, 0 to 3 percent slopes, which is closely associated with it and on similar topography. The surface is nearly level and smooth, except where cut by small, winding, intermittent stream channels.

This soil normally lies in narrow bands below the Redding, Corning, Peters, Pentz, and Raynor soils. It occurs along small streams that drain into Dry Creek in the northeastern part of the Area and along streams that drain into Owens and Mariposa Creeks in the southeastern part. The areas are 10 to 50 acres or more in size. The water-holding capacity is moderate. The vegetation is annual grasses and herbaceous plants.

This soil is used almost entirely for range. However, it is capable of producing good irrigated pasture and dryfarmed barley. Several small areas along Canal Creek and lower Dry Creek are planted to vegetable crops, to which a complete fertilizer is applied. (Capability unit IIIw-2; Storie index rating 45)

Bear Creek soils, 0 to 3 percent slopes (BdA).—These undifferentiated soils are limited in extent. They are either too gravelly, too cobbly, or too wet and swampy to be cultivated and are used only for grazing. Tule and cattail are common in the wetter areas. (Capability unit VIIe-3; Storie index rating 23)

Borden Series

The Borden soils are of limited extent in the Merced Area. They generally lie on low, nearly level to gently undulating terraces along the Chowchilla River west of the Santa Fe tracks. They developed in alluvium washed mainly from granitic materials. They are associated with the Pachappa soils.

These soils are well drained, but spots of salts and alkali in some places indicate that they were less well drained in the past. The natural cover consisted of mixed grasses and weeds and scattered oaks and willows.

These soils have a distinct profile. They have moderate accumulations of clay and lime in the subsoil. The subsoil is moderately to strongly alkaline. It has a blocky structure.

The Borden soils are similar to the Snelling soils, except that the Snelling soils have neither accumulations of lime in the subsoil nor spots of excess salts or alkali.

Borden fine sandy loam, 0 to 3 percent slopes (BeA).—Most of this soil is on a low narrow terrace along the Chowchilla River west of the Santa Fe Railroad.

Representative profile:

1. The surface layer, to a depth of 13 inches, is brown, friable, mildly alkaline fine sandy loam. When moist, it has a weak, fine, granular structure; when dry, it is hard and essentially massive. This layer is porous. There are many insect and rodent burrows and many fine grass roots. The lower boundary is abrupt.
2. The upper subsoil is sandy clay loam. It extends to a depth of 19 inches. It has a moderate, columnar structure. The columns are about 3 inches in diameter. They are coated with dark stains and have slightly rounded caps that are lighter colored than the layers above and below. This layer is hard when dry and sticky when wet. It is moderately alkaline and contains segregated lime. There are some roots and burrows. The transition to the layer below is clear.
3. The lower subsoil is brown sandy clay loam. It extends to a depth of 36 inches. It has a moderate blocky structure but is otherwise similar to the layer above. The transition to the layer below is very gradual.
4. This layer extends to a depth of 47 inches. It is brown fine sandy loam and has weak, blocky structure. It is firm when moist and very hard when dry. The reaction is moderately alkaline. The layer contains both segregated and disseminated lime. Few roots penetrate to this depth. The transition to the next layer is clear.
5. This parent layer is brown, slightly mottled, massive fine sandy loam. It extends to a depth of 60 inches. It contains moderate amounts of disseminated lime but little segregated lime. No roots penetrate to this depth.

This soil is well drained. Permeability is moderate in the surface soil and slow in the subsoil. The water-holding capacity is moderate, and surface runoff is slow to very slow. There is no hazard of water erosion. Fertility is moderate.

This soil is easy to work and well suited to cultivation. Most of the acreage is in dryfarmed grain. A few areas are irrigated and used for alfalfa and cotton. (Capability unit IIs-7; Storie index rating 80)

Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes (BfA).—This soil occurs mainly on the alluvial fan of the Chowchilla River, west of the Southern Pacific tracks. It is associated with Traver, Fresno, and Pachappa soils. The excess salts and alkali concentrated in the upper part of the subsoil are detrimental to some crops. Irrigation and inadequate drainage may result in further accumulation of salts and alkali.

Cotton grows well on this soil, but alfalfa grows poorly in spots. The surface tends to slick over; this slows water penetration and retards plant growth. (Capability unit IIIs-6; Storie index rating 45)

Burchell Series

The Burchell soils occur in slight depressions or nearly flat basins south of Merced. The parent material was alluvium derived mostly from basic igneous rocks but partly from slate and metasandstone.

These soils are kept moist by their imperfect drainage and by the rather high water table. The water table is high because of irrigation nearby. Some areas are flooded, but not frequently.

Soils that are in the same area but have good drainage are the Honcut, Wyman, Yolo, and Marguerite soils. Older alluvium that is seldom or never flooded develops into the dark-colored, slightly saline-alkali Landlow soils and the brownish, saline-alkali Lewis soils.

The Burchell soils are dark grayish brown to dark gray in color. Their texture ranges through silt loam, silty clay, and clay. Their subsoil is mottled grayish brown, and it contains slightly more clay than the surface soil. These soils are generally deep, but in some places weakly cemented sediments lie at a depth of 4 to 6 feet. In many places the water table is at a depth of 2 to 4 feet.

These soils are mildly alkaline to moderately alkaline. Distinct accumulations of lime are present in the subsoil. The soils contain salts and alkali, mostly in low concentrations.

The vegetation is a heavy growth of marsh grasses and rushes.

Burchell silt loam, 0 to 1 percent slopes (BgA).—This soil occurs in nearly level to slightly depressed basinlike areas, principally near and south of Merced.

Representative profile:

1. The surface soil, to a depth of 10 to 24 inches, is silt loam. It is dominantly dark grayish brown, but it ranges from grayish brown to dark gray. This layer is friable and granular when moist, and hard and essentially massive when dry. It is moderately high in organic matter. It is noncalcareous. The reaction is neutral to mildly alkaline. The transition to the subsoil is gradual.
2. The subsoil is grayish-brown, weak, subangular blocky silty clay loam that contains some dark colloidal stains. It is hard when dry and sticky when wet. This layer is moderately alkaline. It contains varying amounts of both segregated and disseminated lime. Soft lime nodules range up to ⅜ of an inch in size. The subsoil varies in thickness, but in most places it is 18 to 20 inches thick.
3. This layer is grayish-brown, somewhat stratified alluvium derived principally from basic igneous materials. It ranges from silt loam to fine sandy loam in texture. It is massive. It is mottled with strong brown, but becomes more bluish with increasing depth. This material is moderately alkaline and slightly calcareous. It contains some nodules of hard lime.

This soil is imperfectly drained. The water table is within 2 to 5 feet of the surface much of the time. Surface runoff is very slow. The permeability is moderate, and the water-holding capacity is high. There is no erosion hazard. Fertility is high.

Most of this soil is cultivated. It is extensively used for alfalfa, irrigated pasture, and cotton. Figs are the only orchard crop. Some rice is grown, and a small acreage is idle. The soil is easy to cultivate, but the plow layer tends to compact and puddle if irrigated and tilled, especially if worked too moist.

Alfalfa and irrigated pasture grow well. Usually they are fertilized with phosphate. Irrigated pasture needs only occasionally to be harrowed, fertilized, and reseeded to maintain a good stand. Cotton yields well under irrigation. Usually a complete commercial fertilizer is used. Dusting with insecticides and defoliants is commonly done by airplane. Rice is seeded and dusted almost entirely by plane. (Capability unit IIw–2; Storie index rating 67)

Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes (BkA).—This soil is similar to Burchell silt loam, 0 to 1 percent slopes, except that it contains variable amounts of salts and alkali, generally concentrated in the subsoil or in the lower part of the surface soil. In places the salts are on the surface because the soil is intermittently ponded and has a high water table. The subsoil is slowly permeable.

This soil is managed in the same way as Burchell silt loam, 0 to 1 percent slopes. The concentration of salts and alkali varies considerably within short distances, resulting in spotty, irregular growth and lowered yields of alfalfa and many other crops. In irrigated pastures, salts tend to collect on the crests of the irrigation checks and in other small spots, but they do not lower the carrying capacity much. Yields of cotton are not greatly affected, although there is some dwarfing of cotton plants. Very little of this soil is idle. Most of the acreage not in crops is used for saltgrass pasture, which grows well. (Capability unit IIw–2; Storie index rating 47)

Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes (BmA).—The largest acreages of this soil are south and west of Merced, in association with areas of Lewis and Landlow soils. Spots also occur within some areas of Burchell silt loam, slightly saline-alkali.

In most places, this soil is dark grayish brown and calcareous throughout. Where irrigated it has a dispersed and puddled appearance. When it is plowed, it forms hard, rounded, prominently mottled, deflocculated clods.

Most areas are in saltgrass range. Some cotton is grown, but growth is spotty. Rice is grown successfully. Flooding for rice tends to leach out some of the salts, but it leaves the soil puddled and in poor tilth. Barley is commonly grown following several years of rice.

Flooding, or a combination of flooding and applying gypsum, helps to reduce the concentrations of salts and alkali. (Capability unit IIIw–6; Storie index rating 20)

Burchell silty clay loam, 0 to 1 percent slopes (BnA).—This soil is similar to Burchell silt loam, 0 to 1 percent slopes, and it is associated with the same soils. It differs principally in texture. The surface soil is silty clay loam, and the subsoil is heavy silty clay loam to light clay. The permeability is slow. The depth to and amount of calcareous material is rather variable over short distances. This soil is intermittently ponded during the rainy season. The water table is at a depth of 2 to 6 feet; it is currently maintained by irrigation water.

This soil is used and managed in much the same way as Burchell silt loam, 0 to 1 percent slopes, but more care is required to avoid puddling and to prevent the formation of large clods. Artificial drainage by open ditches is fairly effective in some areas. Rice, cotton, figs, and alfalfa do well. (Capability unit IIw–2; Storie index rating 60)

Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes (BpA).—Except for slightly finer texture, this soil is similar to Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes, and the two soils are managed in the same way.

Figs are not raised on this soil. Stands of grain and alfalfa are spotty. Cotton and irrigated pasture show only slight effects from the excess salts and alkali. Dry-farmed grain is planted every other year after the first rains in the fall. Some milo is also grown under irrigation; it is preirrigated and then given one or more irrigations during the growing season. (Capability unit IIw–2; Storie index rating 42)

Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes (BrA).—Except for finer texture, this soil is similar to Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes. It is used and managed in the same way. (Capability unit IIIw–6; Storie index rating 18)

Columbia Series

The Columbia soils occur on low natural levees along the San Joaquin River. They developed from recent alluvium derived from various acid igneous rocks and some metamorphic rocks and washed from a large drainage area in the Sierra Nevada. Drainage is imperfect. The vegetative cover consists of a thick growth of willows, cottonwoods, weeds, and grasses.

The Columbia soils are associated with the finer textured Temple and Merced soils, which are the most common soils of the flood plains. Piper soils occupy humps of wind-deposited material and remnants of older natural levees

that stand above the flood level and have accumulated considerable amounts of salts. The Hanford soils developed from the same kind of alluvium as the Columbia soils but are well drained.

The outstanding characteristics of the Columbia soils are their fine sandy or coarse silty texture, their stratified and nearly unweathered profile, and the distinct, strong-brown mottling in otherwise pale-brown to light brownish-gray alluvium. The reaction is generally neutral; lime in the subsoil is rare.

In the Merced Area, deep Columbia soils are limited to flood-plain areas close to the river channel. Most of the soils that are not channeled and streaked with sand are underlain at a depth of 20 to 48 inches by the more clayey Merced soils.

Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes (CaA).—This soil occurs only on low natural levees next to the San Joaquin River. It consists of stratified alluvium that in texture ranges from fine sand to coarse silt. At a depth of 20 to 48 inches it rests directly on the dark-gray, more clayey Merced soil. It is subject to overflow from the San Joaquin River. Fresh alluvium is deposited periodically. Most of the area is cut by channels. The vegetation is a thick growth of willows, cottonwoods, weeds, and grasses.

Representative profile:

1. The surface soil is noncalcareous, slightly hard fine sandy loam. It has a weak, fine, granular structure. It contains large quantities of mica. It is pale brown, light grayish brown, or light brownish gray and is mottled throughout with strong-brown iron stains. It is gray and prominently mottled just above the substratum. The surface soil contains a moderate amount of organic matter. In a few places this layer is more than 48 inches deep. It is deepest near the river, but becomes gradually shallower as the distance from the river increases.
2. The substratum is a buried profile of the Merced or Temple soils. It consists of gray to dark-gray clay or clay loam of mixed alluvial origin.

The surface soil is moderately permeable; the substratum is slowly permeable. The water-holding capacity is moderate. Natural fertility is high. Surface runoff is slow.

Athough this soil is easily tilled and is suited to a wide range of field and truck crops, it is subject to frequent flooding, channel cutting, and deposition of alluvium. Considerable cutting and filling are necessary to level some of the channels. Consequently, most of the area is in range. Irrigated cotton is the only crop that is currently being raised. Yields are good. Dusting with insecticides and defoliants is frequently done by airplane. Since the erection of Friant Dam in Madera County has reduced the flood hazard, more of this soil will probably be leveled and cultivated. (Capability unit IIw–2; Storie index rating 80)

Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes (CcA).—Small spots and narrow bands of this soil occur within larger areas of Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes. Except for the difference in surface texture, the two soils are similar. This silty soil is weakly stratified, but it shows no sign of clay accumulation in the subsoil. The water-holding capacity is high.

This soil is used almost entirely for range. Floods, which usually occur in June, cover the unprotected areas and damage crops. The floods, however, add enough moisture to produce good pasture in July and August. Irrigated cotton is raised in the Turner Ranch area. Cotton is usually planted late in March, after irrigation. It is commonly dusted with a defoliant to hasten maturity and eliminate trash during picking. Most of the picking is done by contract labor, but the use of mechanical pickers is increasing. (Capability unit IIw–2; Storie index rating 80)

Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes (CbA).—This inextensive soil occurs in the extreme western tip of the Merced Area, next to the San Joaquin River and north of the Merced River. It formed from material deposited over the Fresno soils, which have a hardpan substratum. The general topography is nearly level, but the surface is uneven because of sloughs. Salts are concentrated in many places along the edge of the sloughs.

The surface soil is similar to that of Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes, but it has a loam texture. The depth to the gray, calcareous layers of the Fresno soils is about 3 feet. This compact and generally silty substratum contains alkali and limits subdrainage; consequently, salts accumulate in the layer above.

Permeability is moderate above the hardpan. Surface runoff is slow, and much of the area is sometimes flooded. The organic-matter content is moderate.

Most of this soil is either idle or used for range. The hardpan, the salts, and the hazard of overflow have discouraged cultivation. A small acreage north of the Merced River along the San Joaquin River is being leveled and will probably be used for alfalfa or irrigated pasture. (Capability unit IIw–3; Storie index rating 75)

Columbia soils, channeled, 0 to 3 percent slopes (CeA).—These soils formed from material deposited by annual floods of the San Joaquin River. They lie next to the present river bed. The areas are cut by many shallow to moderately deep braided channels. The vegetation is a heavy growth of willows, weeds, cottonwoods, and grasses.

The soil texture ranges from loose sand to silt loam within short distances. The soils are similar in color to other Columbia soils, but they contain less organic matter and are generally deeper. The profile is stratified; it is also distinctly mottled with iron stains. In most places a substratum of Merced clay is at a depth of more than 4 feet. Penetration of roots and moisture is good except during floods or when the water table is high. The water-holding capacity varies; it is low in the loose sands but moderate in the spots of fine sandy loam and silt loam. Because of the many channels, the hazard of flooding, and the need for considerable leveling before cultivation, most of the acreage is now used only for range. (Capability unit IIIe–4; Storie index rating 35)

Corning Series

The Corning soils are on rolling and dissected parts of the oldest alluvial terraces in the Merced Area. They have a hogwallow microrelief. The parent material consisted of beds of poorly sorted gravelly sand, silt, and clay. Apparently it was laid down in broad fans by heavily laden streams that drained an area of mixed

igneous rocks. The vegetation is mainly alfileria but includes some grasses and small bulb plants.

The largest acreage of these soils is northeast of Merced, but a good-sized area occurs northeast of Snelling and smaller areas occur elsewhere. Associated with the Corning soils are the more nearly level soils of the Redding series.

The Corning soils are characterized by the large amount of gravel and cobblestones throughout the profile. They have a pronounced claypan layer. The surface soil is pale reddish brown to yellowish red, and the subsoil is red. The reaction is medium acid to strongly acid.

The gravel and cobblestones in the profile make these soils unsuitable for intensive cultivation. Fertility is low. The soils are especially deficient in nitrogen and phosphorus.

Corning gravelly sandy loam, 0 to 8 percent slopes (CkB).—This hummocky soil is on high terraces and is associated with the Redding, Hopeton, Pentz, Raynor, and Amador soils. It occurs northeast of Merced.

This soil developed on old alluvial valley fill washed from mixed igneous rocks.

Representative profile:

1. The surface soil, to a depth of 11 to 18 inches, is pale reddish-brown to yellowish-red gravelly sandy loam. It is friable and granular when moist, but hard and essentially massive when dry. It is low in organic matter. The reaction is slightly acid to medium acid. The well-rounded, waterworn gravel ranges from 1 to 4 inches in diameter and, in some areas, completely dominates the profile. The lower boundary is abrupt.
2. The subsoil, to a depth of 20 to 36 inches, is medium acid, gravelly or cobbly clay. It is yellowish red when dry and dark red when moist. The lower part is mottled with streaks of yellowish brown. The clay is dense and is extremely hard when dry and plastic when wet. Typically this layer has blocky structure. In many places, however, the structure is masked by the gravel, and only fine, subangular blocks can be noted. The blocks are generally coated with dull-brown colloidal stains.
3. Underlying the subsoil is a gravelly or cobbly clay or clay loam that is generally mottled yellowish brown and has red stains. Some of the gravel and cobblestones show signs of weathering. This material continues to a depth of 10 to 15 feet or more. The yellowish-brown color of the upper part grades to mottled red and gray with increasing depth.

This soil is well drained. Runoff is slow, and the erosion hazard is slight. The surface soil is moderately permeable, but the subsoil is slowly permeable. The available water-holding capacity is low. This soil is deficient in nitrogen, phosphorus, and possibly potassium and minor elements as well.

Because of the large amount of gravel and cobblestones, its hogwallow microrelief, and its undesirable physical properties, this soil is seldom cultivated. It is used mainly for winter and spring pasture, consisting primarily of alfileria and annual grasses. Irrigated pasture is a suitable use for this soil.

Cattle are commonly put on the range in November and remain until May or June. Alfalfa, hay, and wheat straw are used as supplemental feed during dry periods. Rotation of grazing is needed to maintain the range. (Capability unit IVe–3; Storie index rating 18)

Corning gravelly sandy loam, 8 to 30 percent slopes (CkD).—This rolling and hilly soil is widespread in the areas northeast of Merced and northeast of Snelling. It is associated with the Hopeton and Pentz soils. Runoff is rapid, and the erosion hazard is severe. On slopes of more than 20 percent, the mounds are not so high as on the undulating and rolling areas. They appear to be slightly modified and in a few places are oriented in rows up and down the slopes. Concentrations of gravel and cobblestones are present between the mounds.

This soil is used mainly for winter and spring range for beef cattle. A little dryfarmed grain is grown, but yields are low. (Capability unit VIe–9; Storie index rating 15)

Corning gravelly sandy loam, 8 to 30 percent slopes, eroded (CkD2).—This moderately eroded soil occurs where the headcutting of many small, intermittent streams has dissected a rather large part of the high terraces and uplands. Overgrazing during dry years has accelerated the normal geologic erosion, and numerous gullies have been started.

This soil is a little shallower than, but otherwise similar to, Corning gravelly sandy loam, 8 to 30 percent slopes. It is best suited to winter and spring range for beef cattle. (Capability unit VIe–9; Storie index rating 11)

Corning gravelly sandy loam, 30 to 45 percent slopes, eroded (CkE2).—This steep, somewhat excessively drained soil occurs in narrow bands below the break in the undulating Redding soils and above areas in which andesitic tuff material is exposed. The acreage is limited. Most of it is near La Paloma Ranch, west of China Hat.

The dominant slope is about 35 percent. Runoff is rapid, and erosion is active. Numerous deep gullies are eating headward into the high terrace soils.

This soil has a low water-holding capacity. It is of low value for grazing of beef cattle. (Capability unit VIIe–9; Storie index rating 8)

Corning gravelly loam, 0 to 8 percent slopes (CgB).—This soil is similar to Corning gravelly sandy loam, 0 to 8 percent slopes, except that its surface layer has a slightly higher water-holding capacity. The microrelief is hummocky. Large pieces of quartz and quartzite gravel and cobblestones are abundant between the mounds, but very few are on the surface of the mounds. Included are a few small areas that have a cobbly loam surface layer.

This soil has the same kind of vegetation and is used for the same purpose as Corning gravelly sandy loam, 0 to 8 percent slopes. (Capability unit IVe–3; Storie index rating 23)

Corning gravelly loam, 8 to 30 percent slopes (CgD).—This soil is similar to Corning gravelly sandy loam, 8 to 30 percent slopes, except that it has a finer textured surface soil, a slightly higher water-holding capacity, and a moderate erosion hazard. There are large quantities of gravel on the surface and throughout the profile. The surface in most places is sharply rolling to hilly and has a pronounced hummocky or hogwallow microrelief. Most areas have slopes of 10 to 20 percent. This soil is used entirely for beef cattle range. (Capability unit VIe–9; Storie index rating 19)

Corning gravelly loam, 8 to 30 percent slopes, eroded (CgD2).—This soil is similar to Corning gravelly loam, 8 to 30 percent slopes, but it is moderately eroded. The surface, sharply rolling and hilly, is cut by small intermittent streams, drainageways, and gullies. Some deeper gullies have exposed the underlying gravelly and cobbly material.

This soil is used only for range. The vegetation is principally annual grasses and herbaceous plants. (Capability unit VIe–9; Storie index rating 13)

Corning gravelly loam, 30 to 45 percent slopes, eroded (CgE2).—This steep, inextensive soil lies in narrow bands below the gently undulating Redding soils, which occupy the highest terraces. It differs from Corning gravelly loam, 0 to 8 percent slopes, in that its surface soil is thinner, its subsoil is less well developed, it has no hogwallows, and it is cut by numerous deep gullies.

This soil is of low value even for range. Gullies form rapidly along stock trails. (Capability unit VIIe–9; Storie index rating 14)

Corning cobbly loam, 3 to 8 percent slopes (CfB).—This soil has numerous, rounded, waterworn, quartz and quartzite cobblestones and pebbles on the surface and in the profile. It is otherwise similar to Corning gravelly loam, 0 to 8 percent slopes.

This soil is suited only to range. (Capability unit VIe–9; Storie index rating 18)

Corning cobbly loam, 8 to 30 percent slopes (CfD).—This soil is similar to Corning gravelly sandy loam, 0 to 8 percent slopes, but it contains larger pebbles and cobblestones, it has a slightly higher water-holding capacity, and it has steeper slopes. It occurs in small areas, mostly near China Hat. It is associated with the gravelly Corning and Pentz soils.

This soil is used entirely for range. (Capability unit VIe–9; Storie index rating 15)

Daulton Series

The Daulton soils occur in several small, rolling to steep areas along the foothills where Mariposa slate is exposed. The slate has a distinct laminar structure that dips almost vertically. Graphite in the slate makes the outcrops dark colored. Where the slate contains less graphite, Whiterock soils have formed. They are lighter in color and lower in organic matter than the Daulton soils.

The profile consists of 4 to 12 inches of dark-gray silt loam directly over the slate bedrock. It contains many small platy fragments of slate. The reaction is slightly acid to medium acid. The vegetation is grass and a few scattered oaks.

Range is the only suitable use for these soils. In most places they are somewhat eroded because of overgrazing.

Daulton rocky silt loam, 3 to 8 percent slopes (DaB).—This well-drained, shallow to very shallow soil occurs in the foothills in the northeastern part of the Area, in association with Whiterock soils. The largest areas are near the La Paloma Ranch Headquarters. The parent material was weathered in place from gray to dark-gray slate that contains crystals of chiastolite. Areas of this soil are often called tombstone land because there are numerous nearly vertical slaty outcrops. A few gullies, apparently started by overgrazing and trampling, have been cut in the undulating areas.

Representative profile:

1. The surface layer, to a depth of 4 to 12 inches, is gray or dark-gray, friable, weak platy silt loam that contains many platelets of weathered slate. It is slightly acid at the surface and becomes less acid with increasing depth. It is moderately low in organic matter. The lower boundary is abrupt.
2. The parent material is gray and dark-gray, irregularly weathered slate and metasandstone of the Mariposa formation. The slate cleavage planes are steeply sloping; their dip is about 80 to 85 degrees.

This soil is well drained and moderately permeable. Its water-holding capacity and fertility are low. It is difficult to work because of the numerous outcrops. Runoff is medium, and the erosion hazard is moderate. Some loam surface soils are included.

This soil is used only for range. Alfileria is the main forage plant. Cattle are rotated from one large pasture to another, to prevent overgrazing, and are usually moved to irrigated pastures late in May or in June. (Capability unit VIIe–3; Storie index rating 10)

Daulton rocky silt loam, 8 to 30 percent slopes, eroded (DaD2).—Except that it is steeper, this soil is similar to Daulton rocky silt loam, 3 to 8 percent slopes. Most of the slopes are between 12 and 14 percent. The surface is broken by numerous rock outcrops, the largest of which were mapped separately as Slate rock land. The hilly areas are moderately eroded. Many gullies are actively cutting headward. Runoff is rapid, and the erosion hazard is severe.

This soil is entirely in range, which is its best use. (Capability unit VIIe–3; Storie index rating 7)

Delhi Series

The Delhi soils are generally north and west of Livingston, on a broad, recent alluvial fan of the Merced River. The fan is made up of medium and fine sand interbedded with very fine sand and silt. The slopes are gently undulating. A few areas have a dune topography.

The parent material was derived almost entirely from granitic alluvium. It was recently deposited and has been modified by wind erosion. The wind action has made the soils deep and uniform, but some thin, laminar bedding in the silty strata remains to suggest the water-laid origin of the material. Where the water table was high, Hilmar and Dello soils formed from this material. Similar but less sandy alluvium, unmodified by wind, was the parent material of the Hanford and Greenfield soils. Older soils that are related to the Delhi soils are the wind-modified Atwater and the unmodified Snelling.

The Delhi soils are deep and uniform. They are excessively drained to somewhat excessively drained. The normal profile consists of pale-brown sand or loamy sand, slightly more yellowish with increasing depth. The soils are droughty and very low in nitrogen and organic matter. Some areas, where the root zone contains layers of very fine sand and silt, are less droughty and considerably more productive. Except for deficiencies of zinc and other minor elements, the mineral fertility is fairly good. The vegetation consists of annual grasses, herbs, and a few scattered oaks.

These soils are used for growing deep-rooted crops and sweetpotatoes.

Delhi sand, 0 to 3 percent slopes (DfA).—This gently undulating soil lies on the broad, sandy, alluvial fan west of Ballico and around Livingston.

Representative profile:

1. The surface soil, to a depth of 6 to 10 inches, consists of pale-brown, nearly neutral sand slightly darkened by a trace of organic matter. The sand is loose and incoherent. It

contains hardly enough silt or clay to stain the fingers when moist. The transition to the layer below is very gradual.

2. The layer below is pale-brown, nearly neutral sand that becomes light yellowish brown with increasing depth. In a few places it has a thin layer of slightly finer textured, yellowish, mottled material. The sand may extend to a depth of 10 feet or more but more commonly is underlain, at a depth of more than 5 feet, by strata of gray silty material.

Included are some small areas or streaks of sandy material that were laid down by floods that broke out of the Merced River bottom lands near Stevinson and Hilmar. These streaks are generally a little coarser textured than Delhi sand, 0 to 3 percent slopes, especially in the subsoil.

This soil is deep, excessively drained, and very rapidly permeable. The water-holding capacity is very low. There is little or no runoff. The wind erosion hazard is severe, and water erosion is evident where irrigation water has been applied too rapidly. This soil is deficient in nitrogen, sulfur, and zinc.

At least half of this soil is used for orchard crops, grapes, melons, alfalfa, and sweetpotatoes. About one fourth is idle each year. Most of the remainder is used for range. A small part is in irrigated pasture.

Nitrogen fertilizers and manure are used extensively, and some phosphate and sulfur are added for alfalfa. Zinc sprays are used on tree and vine crops. Common systems of irrigation include the use of large underground pipes or large ditches with concrete weirs, and border checks, basin checks, or contour checks. Furrow irrigation is used only for melons and sweetpotatoes.

This soil is easily worked and can be irrigated without difficulty if the fields are arranged in short checks so that large amounts of water can be applied quickly. The moisture-holding capacity is so low that frequent irrigation is essential. The application of more water than the soil can hold, however, causes leaching and raises the water table. This tends to waterlog the Dello soils, which are in the depressions. (Capability unit IVe-4; Storie index rating 46)

Delhi sand, 3 to 8 percent slopes (DfB).—This soil includes remnants of old dunes that have been stabilized by grass or have been leveled and irrigated and stabilized by cropping. It is like Delhi sand, 0 to 3 percent slopes, but because of the steeper slopes it is likely to erode when irrigated. Sprinklers, contour furrows, or contour checks are the best means of irrigating. A large head of water is required to provide quick, light applications. Contour check irrigation is generally used in orchards. Where alfalfa or sweetpotatoes are grown, there is considerable washing. In some places establishing alfalfa is difficult. (Capability unit IVe-4; Storie index rating 43)

Delhi sand, 8 to 15 percent slopes (DfC).—This soil occurs principally along the edges and escarpments of the entrenched Merced River flood plain. Some areas of it are farmed. It is difficult to irrigate because breaks occur in the checks or furrows. Gully erosion results. Any irrigation should be by sprinkling or on the contour, and the water should be brought in by pipeline. Special care is needed in handling the flow of water. (Capability unit IVe-4; Storie index rating 41)

Delhi loamy sand, 0 to 3 percent slopes (DdA).—This soil is associated with Delhi sand, 0 to 3 percent slopes. It is slightly less droughty than the associated soil and a little less severely affected by wind erosion when cultivated. Crops germinate more readily, and yields are greater.

Most of this soil is cultivated. It is used for much the same crops as Delhi sand, 0 to 3 percent slopes. Frequent, light applications of irrigation water are required, but the runs may be slightly longer or the head of water slightly smaller than on the Delhi sands. Alfalfa, grapes, and sweetpotatoes are the most common crops. (Capability unit IIIe-4; Storie index rating 68)

Delhi loamy sand, 3 to 8 percent slopes (DdB).—This soil is similar to Delhi sand, 3 to 8 percent slopes, but it has a little higher water-holding capacity. It occurs on remnants of old dunes and along the edge of the Merced River flood plain. The largest areas are near Ballico and Cressey.

About half of this soil is cultivated; the rest is idle. (Capability unit IIIe-4; Storie index rating 65)

Delhi loamy fine sand, 0 to 3 percent slopes (DbA).—This soil is similar to Delhi sand, 0 to 3 percent slopes, but it is finer textured and more coherent, and it has a higher moisture-holding capacity. The hazard of wind erosion is less; erosion occurs only when a field is dry and cultivated. Some spots of Delhi sand, silty substratum, 0 to 3 percent slopes, are included.

Most of this gently undulating to nearly level soil is cultivated. It is easy to irrigate. Nitrogen is the principal fertilizer used. The common crops are alfalfa, grapes, almonds, peaches, melons, grain, and beans. (Capability unit IIIe-4; Storie index rating 73)

Delhi loamy fine sand, 3 to 8 percent slopes (DbB).—Except for slope, this soil is similar to Delhi loamy fine sand, 0 to 3 percent slopes. It is limited in extent, and individual areas are small. Some areas may be suitable for leveling, but most areas are not cultivated. (Capability unit IIIe-4; Storie index rating 69)

Delhi sand, silty substratum, 0 to 3 percent slopes (DgA).—This soil occurs throughout the area of Delhi soils. The upper part of the profile is like that of Delhi sand, 0 to 3 percent slopes, but at a depth of 1 to 4 feet are lenses and strata of light-gray silt loam or very fine sandy loam. This silty material improves the moisture-holding capacity and modifies the excessive permeability of the soil. The substratum retains enough moisture and plant nutrients to serve as a good medium for growing deep-rooted crops.

This soil is generally neutral and noncalcareous to a depth of at least 4 feet. It differs from the Dinuba soils in that it is coarser textured, does not contain lime in the subsoil, and is well drained.

This soil is low in organic matter and is deficient in nitrogen, sulfur, and zinc. There is little or no runoff, but the hazard of wind erosion is severe.

Most of this soil is cultivated to peaches, almonds, melons, grapes, and alfalfa. Yields of peaches are among the highest in the Merced Area. In a few places peaches and almonds show evidence of sodium burn and potassium deficiency. This may result from very thin layers of sodium concentrated at the upper boundary of the silty substratum layers. It can usually be corrected by heavy applications of potash fertilizer.

Irrigations should be frequent but light, to avoid leaching the sandy surface soil and saturating the subsoil. However, this soil need not be irrigated so often as the more droughty Delhi sands, except on very young orchards

or new plantings of alfalfa that have not established their roots in the subsoil. Overirrigation is common because the surface soil dries out rapidly and the moisture held in the subsoil is not apparent. (Capability unit IIIe-4; Storie index rating 51)

Delhi sand, silty substratum, 3 to 8 percent slopes (DgB).—Most of this soil is south of Ballico. It is similar to Delhi sand, silty substratum, 0 to 3 percent slopes, except that it is more difficult to irrigate because of the steeper slopes. Contour checks are used.

This soil is used for sweetpotatoes, melons, and some orchard crops. Several small areas of loamy sand are included. (Capability unit IIIe-4; Storie index rating 48)

Delhi loamy sand, silty substratum, 0 to 3 percent slopes (DeA).—This soil differs very little from Delhi sand, silty substratum, 0 to 3 percent slopes. It is slightly finer textured; consequently, it has a slightly higher moisture-holding capacity, is more fertile, and has a more coherent surface layer. The hazard of wind erosion is moderate.

Nearly all of this soil is irrigated, and at least 75 percent is in crops each year. Peaches, almonds, grapes, sweetpotatoes, melons, strawberries, and alfalfa are the principal crops. Yields vary, depending upon fertilization and skill in irrigation. (Capability unit IIIe-4; Storie index rating 73)

Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes (DcA).—This soil is similar to Delhi sand, silty substratum, 0 to 3 percent slopes, except for the finer texture of the surface soil. The depth to the silty substratum is less in many places, however, and the silty material is mixed into the surface soil. The water-holding capacity is moderate. Fertility is moderate, except for deficiencies of nitrogen, zinc, and sulfur.

This soil is used for a wide range of crops. (Capability unit IIIe-4; Storie index rating 77)

Dello Series

The Dello soils lie in depressions blown out by the wind within areas of Delhi soils. They are imperfectly drained to poorly drained. The surface of the soils is within the range of capillary rise from the water table. The depth to the water table varies from nothing to several feet, depending on irrigation and rainfall.

These soils have been strongly affected by the excessive moisture. The surface layer is olive gray and has bluish-gray iron mottles. The layer below is light gray and has strong-brown mottles.

Most areas are covered with a dense growth of bermudagrass or saltgrass and willows. The places where the saltgrass grows are strongly alkaline to very strongly alkaline. Salts are normally concentrated in a thin layer at or near the surface.

Dello sand, 0 to 1 percent slopes (DkA).—This imperfectly drained soil lies in oval or elongated depressions of 3 to 30 acres throughout the areas of Delhi soils. Because of the high, fluctuating water table, it is grayer than the Delhi soils and has many distinct bluish-gray and strong-brown mottles in the subsoil. The reaction is mildly alkaline in most places, and small spots are weakly calcareous or have very slight accumulations of salts and alkali.

This soil is deep and very rapidly permeable. There is little or no runoff and only a slight hazard of erosion. The water-holding capacity is very low. Natural fertility is moderately low. Supplies of sulfur, zinc, and nitrogen are deficient.

Most of the areas where the water table is at a depth of more than 3 feet are farmed along with the better drained surrounding areas. Peaches, almonds, or grapes are likely to be affected by chlorosis and other diseases. Alfalfa and shallow-rooted crops are little damaged, however. Surface drainage in most areas is almost out of the question because of topography. Pumping to lower the water table is considered the best solution. Drainage pumps are being installed in critical areas by the irrigation districts. (Capability unit IIIw-4; Storie index rating 46)

Dello sand, slightly saline-alkali, 0 to 1 percent slopes (DoA).—This imperfectly drained soil is similar to Dello sand, 0 to 1 percent slopes, except that it contains a slight accumulation of salts and alkali. It lies mainly in depressions, particularly along the western and southern borders of the sandy area west of Delhi and Atwater, and in some nearly level areas that have a high water table. The salts and alkali are normally at the upper margin of moist soil, and their position may fluctuate with the water table. Saltgrass and spikeweed are common.

Because of its coarse texture and the concentrations of salts and alkali, most of this soil is idle or is used for pasture. Unsuccessful attempts have been made to grow vineyards, orchards, and alfalfa and clover pastures. Crops often show symptoms of potassium deficiency and sodium burn. The first step to correct this is drainage to lower the water table, which requires a large-scale community drainage system or the use of drainage pumps. Irrigation should quickly correct the alkali condition, once drainage has been established. (Capability unit IIIw-4; Storie index rating 36)

Dello sand, poorly drained, 0 to 1 percent slopes (DmA).—This poorly drained soil is in depressions within the Delhi sand area. It usually is moist throughout and has a water table within 3 feet of the surface. It is similar to Dello sand, 0 to 1 percent slopes, except that it is olive gray and is mottled at or near the surface with bluish gray. The reaction ranges from slightly acid to mildly alkaline.

The vegetation in most places consists of a dense growth of willows, bermudagrass, saltgrass, and rushes. Most of the acreage is uncultivated. Some is used for irrigated pasture. (Capability unit IVw-4; Storie index rating 17)

Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes (DnA).—This poorly drained soil is in depressions. The salts and alkali are concentrated in a thin layer at the surface. Brown or black organic stains have been produced by the strongly alkaline salts.

The vegetation invariably includes saltgrass. In many places there are other salt-tolerant plants. These areas are largely uncultivated, except for a few spots in irrigated pasture. (Capability unit IVw-4; Storie index rating 14)

Dello loamy fine sand, 0 to 1 percent slopes (DhA).—There are only a few small areas of this soil, which is similar to Dello sand, 0 to 1 percent slopes, except for the finer texture. In places the subsoil contains lumps and lenses of light-gray silty material that is hard when dry but friable when moist. Many of these lumps and lenses are faintly mottled or stained, particularly at their upper surface, with strong-brown or brown organic matter.

This soil occurs near Ballico and Delhi and westward toward Hilmar. Included are a few level areas and a few that are slightly undulating. Also included are several sizable areas of fine sand. Because of the silty subsoil, the difference in texture makes a small difference in the moisture-holding capacity.

This soil is used principally for irrigated pasture. (Capability unit IIIw-4; Storie index rating 65)

Dinuba Series

Dinuba soils occur near Hilmar and Stevinson, on the western part of the recent alluvial fan of the Merced River. The parent material was granitic alluvium of sandy loam texture, underlain at a depth of 2 to 4 feet by hard, silty material. The slopes are nearly level. Runoff is slow to very slow. Drainage is generally imperfect to moderately good, but local areas have poor drainage and a high water table. The vegetation consists of grasses, small herbaceous plants, and a very few scattered oaks. Sedges and willows grow in poorly drained areas, and saltgrass and other salt-tolerant plants in saline-alkali spots.

The surface soil is light brownish-gray to pale-brown, neutral to mildly alkaline sandy loam. It is hard when dry but friable and easily worked when moist. The subsoil, slightly finer textured than the surface soil, is light brownish gray mottled with strong brown and is slightly to moderately calcareous. The silty substratum is slightly calcareous. It is firm when moist. At its upper surface it is weakly cemented in spots into thin lenses, so that it forms a weak hardpan resembling that in the Fresno soils.

The Dinuba soils are associated with the Hilmar soils, but the Hilmar are distinguished by loamy sand or sand textures, poor and imperfect drainage, and lack of subsoil development. The Dinuba soils also resemble the Pachappa soils, but the Pachappa soils lack the silty substratum, are grayish brown, and have a weakly developed subsoil that contains more clay than that of the Dinuba soils.

Dinuba sandy loam, 0 to 1 percent slopes (DpA).—This soil lies near Hilmar and Stevinson, mainly near the Merced River.

Representative profile:

1. The surface soil, to a depth of 14 to 20 inches, is light brownish-gray to pale-brown, micaceous sandy loam. It has weak, fine, granular structure when moist and is essentially massive when dry. This layer is mildly alkaline but noncalcareous. The lower boundary is gradual.
2. The subsoil, about 6 inches thick, is light brownish-gray, mottled, weakly calcareous, heavy sandy loam. It is more coherent than the surface layer because it contains more clay. The lower boundary is abrupt.
3. The underlying material consists of light-gray, silty lenses or strata that contain slight to moderate amounts of segregated lime. The material is weakly cemented into a thin hardpan in some places. The amount of lime decreases a little with increasing depth. The lenses of silty material stratified with sand extend to a considerable depth. The water table is at a depth of more than 3 feet.

Included are areas of fine sandy loam, some of which may be the result of removal of the sandy loam surface soil by leveling. Some areas of sandy alluvium deposited in a thin layer over Fresno soils are also included.

This soil is moderately deep. Permeability is moderate through the upper layers of the soil, but slow in the substratum. Drainage is imperfect, and the depth to the water table fluctuates between 3 and 5 feet. Surface runoff is slow, and there is no erosion hazard. The fertility is moderate. Nitrogen and, in places, zinc and sulfur are deficient.

Most of this soil is cultivated and irrigated. Alfalfa, field crops, melons, and grapes are the principal crops. Irrigated pasture is grown for dairying northwest of Stevinson and southwest of Hilmar. Irrigation should be carefully controlled to prevent the accumulation of excess salts and alkali as the result of raising the water table. (Capability unit IIw-3; Storie index rating 77)

Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes (DrA).—This soil is generally in low-lying areas. Most of it is northeast of the Hills Ferry bridge, where the water table is almost always within 4 feet of the surface. It differs from Dinuba sandy loam, 0 to 1 percent slopes, in that the surface soil is slightly calcareous in spots and has brown or brownish-black organic stains due to the effects of alkaline salts. This soil is used for pasture, alfalfa, beans, and silage corn. Irrigation maintains the high water table. A small area is used only for saltgrass pasture. (Capability unit IIw-3; Storie index rating 60)

Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes (DsA).—Most of this soil lies southeast of Stevinson and north of Livingston. It is similar to Dinuba sandy loam, 0 to 1 percent slopes, except that the water table is within 2 feet of the surface and the soil is mottled with bluish gray. This soil remains moist most of the year, and salt crusts and organic stains occur in spots. Lenses of strongly cemented hardpan, similar to that in the Fresno soils, are present in a few places.

Some of this soil is used for irrigated pasture, but most of it is in saltgrass pasture. Improved drainage might make cultivation more feasible. (Capability unit IIIw-6; Storie index rating 30)

Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes (DtA).—This soil is similar to Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes, except that the salt crusts are thicker and more numerous, and there are more brown organic stains.

This soil is used almost entirely for saltgrass pasture. Reclaiming it for cultivation is difficult because of its position in depressions. (Capability unit IVw-6; Storie index rating 13)

Dune Land

This miscellaneous land type consists mainly of fine sand blown from the Delhi soils. The general relief is undulating. The microrelief is typical of areas where wind erosion is active. There is little vegetation.

Dune land, 0 to 3 percent slopes (DuA).—Leveled areas of this land type can be cultivated in the same way as Delhi sand, 0 to 3 percent slopes. Extreme care is necessary to avoid leaving the surface bare and exposed to the wind. The soil material is so sandy that it is extremely droughty, and yields depend on careful irrigation and management. Almost the only vegetation is rows of cane planted to help control erosion. (Capability unit IVe-4; Storie index rating 23)

Dune land, 3 to 8 percent slopes (DuB).—This miscellaneous land type consists of active dunes. The dunes have a knife-edge shape in some areas, a wave form in others. These areas should be stabilized with windbreaks and left undisturbed as much as possible. If leveled, this soil would be similar to Delhi sand, 0 to 3 percent slopes. Leveling would require moving large volumes of material, and the resulting soil would not be of high value. (Capability unit IVe-4; Storie index rating 16)

Exchequer Series

The Exchequer soils occur mainly in the northern corner of the Merced Area. Smaller areas are scattered along the eastern boundary of the Area, at the edge of the Sierra Nevada foothills. The relief is generally hilly, but it ranges from gently sloping to steep. The parent material weathered in place from basic igneous rocks. In some places these rocks, known as greenstone, are somewhat metamorphosed. Rows of bedrock outcrops run parallel to the bedding planes of the rock, roughly northwest to southeast. Areas nearly covered with these outcrops are mapped as Schist rock land.

These soils show only a trace of profile development, because geologic erosion has kept pace with soil formation. They are associated with the Whiterock soils, which developed on slate and metasediments. They are also associated with and similar to the Auburn soils, which developed on similar parent material but are shallow to moderately deep and have slightly more clay in the subsoil than in the surface soil.

These soils are yellowish red. They range in depth from 4 to 18 inches. The reaction is slightly acid. The principal vegetation is grass. A few oaks grow, some in small clusters around rock outcrops.

The numerous rock outcrops make these soils unsuitable for cultivation.

Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes (EaD).—This undifferentiated group of Exchequer and Auburn silt loams consists principally of Exchequer rocky silt loam. Auburn rocky silt loam occupies up to 50 percent of the more gently rolling areas. Areas that contain almost nothing except outcrops of rock have been mapped separately as Schist rock land.

These soils are almost equally divided between rolling and hilly topography. Because of the nearly vertical outcrops of platy bedrock, these areas are often called tombstone land. The vegetation consists of grasses and herbs and a few scattered oaks.

Representative profile of Exchequer silt loam in an area between rock outcrops:

1. The surface soil is friable, yellowish-red to brownish-red silt loam. It has a weak, fine, granular structure when moist, but it is hard and essentially massive when dry. A layer of partly decomposed organic matter less than ¼ inch thick lies on the surface. The normal range in thickness is from 4 to 18 inches. Except for slightly redder color in the lower part, the layer is practically uniform throughout. The boundary between the soil and the weathered, basic, meta-igneous parent rock is abrupt.

Normally, this soil is slightly acid; the pH ranges from 6.0 to 6.5.

A representative profile of Auburn rocky silt loam is described under the heading "Auburn rocky silt loam, 3 to 8 percent slopes."

Because of rock outcrops, shallowness, and rolling and hilly topography, these soils are suitable only for range. The cover of alfileria, soft chess, wild oats, and other annual grasses furnishes good winter and spring feed to beef cattle. A few acres was planted to grain some years ago, but tillage and harvesting were extremely difficult, and the project was abandoned. There are a few scattered groups of oak trees, generally on or adjacent to the larger outcrops. The trees have little value, but they provide scanty shade for livestock.

This soil is generally low in organic matter, nitrogen, and possibly phosphorus. Surface runoff is rapid, and erosion is moderately active. Few gullies occur, however, where the soil is covered with grass. (Capability unit VIIe-3; Storie index rating 19)

Foster Series

The Foster soils are inextensive in the Merced Area. They formed from granitic alluvium of fine sandy loam texture. They occur in small, poorly drained or very poorly drained depressions and oxbows on the flood plain of the Merced River, in association with soils of the Grangeville series. The water table is generally less than 3 feet below the surface, and it fluctuates seasonally with the level of the river. The vegetative cover consists of reeds, sedges, and willows and, around the borders of the depressions where salts often accumulate, a fringe of saltgrass or bermudagrass.

The Foster soils are gray or dark grayish brown and distinctly mottled. They have no accumulation of clay in the subsoil, but in many places they are somewhat stratified in the lower part with clean white sand mottled with strong brown or bluish gray. Lime occurs here and there. In very poorly drained spots, which are generally wet at or near the surface most of the year, there is commonly a peaty or mucky layer, 1 to 3 inches thick, of more or less decomposed organic matter.

The associated Grangeville soils are imperfectly drained, grayish brown, and less mottled than the Foster soils.

Foster fine sandy loam, 0 to 1 percent slopes (FaA).—This poorly drained soil lies in shallow depressions and abandoned channels on the Merced River flood plain. It is distinctly mottled. The fluctuating water table is usually at a depth of 1 to 3 feet but is at or above the surface when the river is high in spring. The vegetation includes cattails, rushes, and willows. The total area is not large, but, because this soil is often too wet to cross with farm machinery, it seriously interferes with cultivation of the better drained soils nearby.

Representative profile:

1. The surface soil, to a depth of about 20 inches, is gray fine sandy loam mottled with strong brown. It is soft when dry and friable when moist. It has weak, very fine, granular structure. This layer is high in organic matter. It contains many roots. It is mildly alkaline (pH 7.5) and slightly calcareous. The lower boundary is clear and smooth.
2. The subsoil, to a depth of about 30 inches, is gray fine sandy loam distinctly mottled with strong brown. It is massive and friable. It is high in organic matter but contains few roots. It is mildly alkaline (pH 7.5) and moderately calcareous; the amount of lime decreases with increasing depth.
3. Below a depth of 30 inches, the soil is light brownish-gray, mottled material, similar to the layer above but in many places stratified with clean white sand.

A few areas are free of lime. Most areas of this soil are used only for permanent pasture. (Capability unit IIIw-2; Storie index rating 38)

Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (FdA).—This soil lies in many of the depressions on the Merced River flood plain. A narrow fringe of salts and alkali has accumulated around the border of each area. If leveling has filled the depression, salts are likely to reappear at the surface. Saltgrass and spikeweed usually grow on these areas. Unleveled areas are used only for pasture. (Capability unit IIIw-2; Storie index rating 26)

Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes (FbA).—This soil lies in depressions and old channels on the Merced River flood plain. For part of the year it is ponded or has a water table at or near the surface. It is similar to Foster fine sandy loam, 0 to 1 percent slopes, but is mottled with bluish gray and strong brown, and in places has mucky layers in the surface soil. In many places the smell of swamp gas can be detected. The vegetation is mainly willows, cattails, and rushes.

These areas are too low and too wet for cultivation or drainage. In some places, however, materials from adjacent soils have been deposited on top of this soil in leveling, and these areas are farmed. If the water table of the entire bottom land can be lowered, farming this soil will probably be feasible. (Capability unit VIw-6; Storie index rating 19)

Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes (FcA).—This soil is similar to Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes, but it is very poorly drained and reclamation is less likely to be successful. Except for a few small spots in irrigated pastures, none of this soil is cultivated. (Capability unit VIw-6; Storie index rating 13)

Foster gravelly fine sandy loam, 0 to 1 percent slopes (FeA).—This soil is on the Merced River bottom land, in overflow channels and old oxbows. It resembles Foster fine sandy loam, 0 to 1 percent slopes, except that it contains moderate concentrations of gravel. The texture varies.

This soil is unfit for cultivation. Even with improved drainage, it would be of low value. It is used entirely for pasture. (Capability unit VIw-6; Storie index rating 23)

Fresno Series

The Fresno soils occur mostly on a broad, nearly level plain south of Dutchman Creek. They extend westward from the Southern Pacific Railroad to the flood plain of the San Joaquin River. In many places there is a low mound microrelief. Surface drainage and internal drainage are very slow. Recent dry years have lowered the water table to considerable depth, but in the past, apparently, the water table was close to the surface. Artesian wells formerly flowed in some areas that now are dry.

The sandy, granitic alluvium from which the Fresno soils formed was laid down largely by the Chowchilla River and is similar to the alluvium from which the Dinuba soils developed.

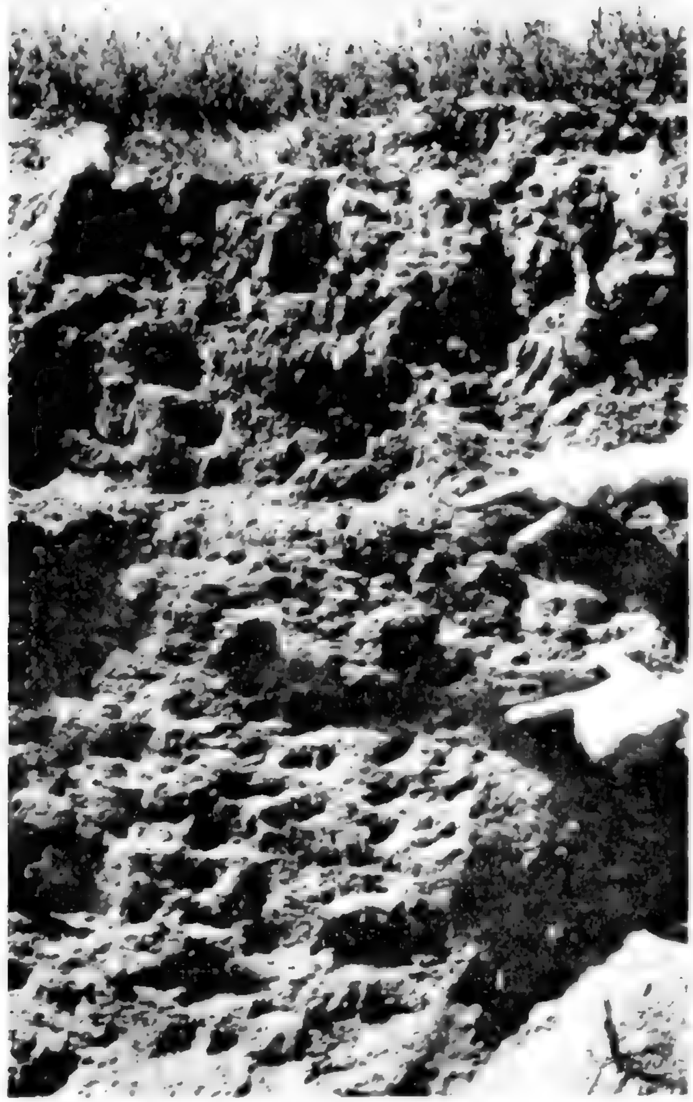

Figure 11.—**Profile of Fresno loam, slightly saline-alkali, 0 to 1 percent slopes. The silica-lime cemented hardpan that is characteristic of this soil lies between the pointing fingers.**

The Fresno soils have a lime-silica cemented hardpan in the lower part of the subsoil and a moderate amount of clay in the upper part (fig. 11). The vegetation consists largely of saltgrass, foxtail, iodinebush, and other salt-tolerant plants.

Associated with the Fresno are several areas of the Lewis soils, which are similar and formed from mixed alluvium, and of the Traver soils, which have no hardpan and only a little clay in the subsoil. Near El Nido, more recent alluvium overlies the Fresno soils and is mapped as Pachappa soils. Soils of the San Joaquin River flood plain form the western boundary of the Fresno soil area.

Fresno loam, slightly saline-alkali, 0 to 1 percent slopes (FpA).—This imperfectly drained soil lies on broad, nearly level plains and in basins in the southern and western parts of the Area. It has some mound microrelief.

Representative profile:

1. The surface soil, to a depth of 2 to 4 inches, is light-gray, hard loam. It is vesicular and has a weak, platy structure. It is almost neutral in reaction. It rests directly on a subsurface layer of essentially massive loam that is only a few inches thick and is mildly alkaline in reaction.
2. The upper part of the subsoil is grayish-brown, very hard clay loam that has prismatic structure. The prisms are coated with dark-brown humus stains. This grades into light yellowish-brown, blocky sandy clay loam that extends in most places to a depth of 18 to 24 inches but in a few areas to a depth of only 11 inches. The entire subsoil is strongly alkaline and moderately calcareous.
3. The strongly cemented, lime-silica hardpan is 6 to 12 inches thick, massive, and almost impermeable to roots and water. Below the hardpan is light yellowish-brown, mildly calcareous fine sandy loam that normally extends to considerable depth.

Some areas included in this unit have sandy loam or fine sandy loam textures.

Permeability is slow through the surface soil and very slow through the subsoil and hardpan. The water-holding capacity is very low. Surface runoff is very slow, and there is no erosion hazard. The supply of available plant nutrients is moderate to low.

At least 80 percent of this soil is used only for range. Some cotton, milo, barley, and pasture are grown. A fig orchard north of El Nido has survived, but yields are low and the trees are growing very slowly.

Soil amendments, such as sulfur or gypsum, should increase the productivity. Reclamation by flooding or by growing rice may be feasible if drainage can be established. The impermeable hardpan makes reclamation difficult because the excess salts and alkali cannot be washed downward. Chisels pulled by large tractors are sometimes used to rip up the hardpan before flooding. However, this soil will not be highly productive even after the excess salts and alkali are removed. (Capability unit IIIs–8; Storie index rating 21)

Fresno loam, moderately saline-alkali, 0 to 1 percent slopes (FrA).—This soil lies in broad areas north of El Nido. Except that it has stronger concentrations of salts and alkali, it is similar to Fresno loam, slightly saline-alkali, 0 to 1 percent slopes. Northeast of El Nido, the hardpan is at a depth of 10 to 18 inches. Several areas of sandy loam and a few areas of loamy fine sand and fine sandy loam are included.

This soil is poorly suited to cultivation. It is now used only for range. Reclamation is of doubtful value unless the hardpan can be broken by deep chiseling. (Capability unit IVs–8; Storie index rating 8)

Fresno loam, strongly saline-alkali, 0 to 1 percent slopes (FsA).—This soil is similar to Fresno loam, slightly saline-alkali, 0 to 1 percent slopes, except that it contains strong concentrations of alkali and salts. It is almost barren even of alkali-tolerant weeds except during a short period in the spring. This soil contains so much salt and alkali and is so impermeable and infertile that it is of no value for cultivation. Reclamation is costly. In a few spots the soil has fine sandy loam or loamy fine sand texture, and in several areas it is very shallow over the hardpan. (Capability unit VIs–8; Storie index rating 3)

Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes (FmA).—This soil lies along McSwain Road south of Atwater and Livingston. In this area excess irrigation water and water from deep wells are used to maintain large duck ponds for hunting clubs. The resulting general high water table keeps many areas swampy or intermittently ponded.

This soil is prominently mottled. It is a little darker colored than Fresno loam, slightly saline-alkali, 0 to 1 percent slopes. It is covered with saltgrass and clumps of cattail and tule. The ponded water is high in sodium, and it leaves white fringes of salts and local brown stains. Some irrigated pastures include areas of this soil, but the only grasses that survive are those that are tolerant of excess water and salts. Improved drainage should make it possible to grow irrigated pasture and alkali-tolerant crops. (Capability unit VIs–8; Storie index rating 4)

Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes (FnA).—This soil is located near and is similar to Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes, but it has moderate concentrations of salts and alkali. Saltgrass is a little less dense. Many of the small ponds are brackish and have the brown color associated with a high content of sodium.

This soil is grazed and is used for duck hunting. It is unsuitable for cultivation. Reclamation is costly. (Capability unit VIs–8; Storie index rating 2)

Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes (FoA).—This soil is similar to Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes, except that it has strong concentrations of salts and alkali. Salt crusts and brown or black scum cover most of the areas except when they are flooded.

Practically no plants grow on this soil. There is little possibility of reclamation for crops other than irrigated pasture. (Capability unit VIs–8; Storie index rating 1)

Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes (FfA).—This soil is scattered through the basin, mostly on flats or in slight depressions. It is associated with the Fresno loams. It differs from Fresno loam, slightly saline-alkali, 0 to 1 percent slopes, in that its surface layer is less than 2 inches thick and consists of platy fine sandy material overlying a clay loam subsurface layer. The mound microrelief covers fewer areas than on the Fresno loam soils. In a few places this soil is very shallow.

This soil is more difficult to work than Fresno loam, slightly saline-alkali, 0 to 1 percent slopes, because of its finer texture. Reclamation would be more difficult because water penetrates more slowly. (Capability unit IIIs–8; Storie index rating 16)

Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes (FgA).—This soil is similar to Fresno loam, moderately saline-alkali, 0 to 1 percent slopes, except that it has finer texture. In some spots in the southwestern corner of the Area, the surface horizon is darker than typical.

This soil is used entirely for range. (Capability unit IVs–8; Storie index rating 7)

Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes (FkA).—This soil is similar to Fresno loam, strongly saline-alkali, 0 to 1 percent slopes, except that it has a finer textured, thinner surface layer. Most areas are covered with a very sparse growth of saltgrass and iodine-

bush. This soil is now used only for range. (Capability unit VIs–8; Storie index rating 2)

Grangeville Series

The Grangeville soils occur near the western end of the Merced River flood plain and on alluvial fans. The water table is high and fluctuating. In the past, these soils were flooded frequently by the Merced River. The Exchequer Dam in Mariposa County partly controls flooding. Since it was built, in 1926, there has been only one serious flood. The vegetative cover consists of a dense growth of grasses and weeds, scattered oaks, and, along the channelways, clumps of willows and cottonwoods.

The soil profile consists of deep, stratified deposits of granitic alluvium that is predominantly sandy but includes considerable silt and very fine sand. The only evidence of weathering is the slightly darker color of the surface soil. The surface soil, principally of fine sandy loam texture, is mottled grayish brown in color. The rest of the profile is light brown and becomes more mottled with increasing depth. All layers are soft and have a weak granular structure. The reaction is mildly alkaline. Disseminated lime occurs at variable depths, depending upon recent fluctations of the water table. Old oxbows and channels within areas of Grangeville soils frequently contain standing water in spring when the water table is high. The Foster soils, which are generally distinctly mottled with bluish or strong-brown stains, occur in these places.

Grangeville fine sandy loam, 0 to 1 percent slopes (GaA).—This imperfectly drained soil lies on the Merced River flood plain. It is subject to floods and to an intermittently high water table. It is nearly level except for a few old channels and oxbows that are poorly drained and contain concentrations of salts and alkali.

Representative profile:

1. The surface layer, to a depth of about 12 inches, is mottled grayish-brown to brown, soft fine sandy loam that has weak, granular structure. It is mildly alkaline and intermittently weakly calcareous. It contains moderate amounts of organic matter.
2. The subsoil differs from the surface soil mainly in color. It is light brown and mottled with strong-brown stains. Disseminated lime generally occurs at depths of 1 to 2 feet. Less commonly, it is present only in deeper layers. In places the content of lime decreases at depths of more than 4 feet. In some places there is a nearly permanent water table at a depth of 3 feet or more.

Small spots of Hanford soils are included.

This soil is deep and moderately permeable and has a high water-holding capacity. Runoff is slow; the only erosion hazard is from cutting by flood waters. This soil is easily worked and has a good granular tilth when cultivated. Its fertility is high.

This soil produces high yields of truck crops, melons, irrigated pasture, sudangrass, and alfalfa. Orchard crops have not been successful because of the high water table and the lime content. Some grapes are grown, but they are low in sugar.

As the water table is now controlled largely by fluctuations in the water level in the Merced River, little can be done to improve the drainage except through equalizing the river flow by building large storage dams. Irrigation is by pumps or through ditches that divert water from the river.

About 35 percent of this soil is undeveloped and used only for pasture. Most of the remainder is in alfalfa and irrigated pasture. Little or no fertilizer is used except on truck crops. Weeds, especially johnsongrass, are troublesome. (Capability unit IIw–2; Storie index rating 80)

Grangeville loam, 0 to 1 percent slopes (GbA).—This soil is similar to Grangeville fine sandy loam, 0 to 1 percent slopes, except that it has finer texture. The two soils are closely associated. The texture ranges from very fine sandy loam to silt loam. This soil is easy to work, although it puddles slightly if worked when too moist.

The flood hazard and the fluctuating water table have limited the use of this soil. About 40 percent remains uncultivated and is used only for pasture. The cultivated part is mainly in alfalfa, irrigated pasture, and sudangrass. Some grapes, orchard crops, and truck crops are grown. Yields are high, but dense growths of weeds, especially johnsongrass, sometimes interfere with harvesting. This is a good soil for alfalfa. (Capability unit IIw–2; Storie index rating 80)

Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes (GcA).—Most of this soil is near the outer edges of the Merced River flood plain and on the alluvial fan near Stevinson. The concentrations of salts and alkali are not uniform but occur in many scattered spots. Saltgrass or alkali weeds generally mark the areas of excess salts and alkali. In most places the water table is 2 to 5 feet below the surface. A system of ditches, tile, or drainage pumps would probably improve conditions measurably. The principal crops grown are irrigated pasture and alfalfa. (Capability unit IIw–2; Storie index rating 70)

Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes (GdA).—This soil generally lies along the the edge of the bottom land, where seepage from higher areas has raised the water table and caused moderate concentrations of salt and alkali. The surface soil is grayer than that of Grangeville fine sandy loam, 0 to 1 percent slopes.

Saltgrass dominates most of these areas, which are used mainly for pasture. Cultivated spots are generally marked by dark-brown stains or scum—indications of excess sodium. Improved drainage plus the addition of gypsum should permit alkali-resistant crops to be grown. (Capability unit IIIw–6; Storie index rating 24)

Greenfield Series

The Greenfield soils lie on the terraces along the Merced River and on the alluvial fan of the Chowchilla River east of the Southern Pacific Railroad. Both areas are nearly level to very gently sloping, but some places have a microrelief of low mounds. These soils developed in granitic alluvium of sandy loam texture. A cemented hardpan, unrelated to the soil above, lies at a depth of 2 to 4 feet. Before cultivation, the vegetation was probably annual grasses and alfileria.

These soils are closely associated with the Snelling soils on the terraces of the Merced River. They are associated with the Madera and Borden soils on the Chowchilla alluvial fan. The Greenfield soils on the alluvial fan apparently formed from alluvium fairly recently deposited

over Madera hardpan soils from which the upper layers had been stripped by erosion.

The Greenfield soils are well drained. They are very slightly acid to neutral in reaction. They have a sandy loam or fine sandy loam surface soil and a heavy sandy loam or light sandy clay loam subsoil. The upper part of the subsoil contains only a slight accumulation of clay, but in some places a thin layer of clay lies directly above the hardpan layer. The hardpan, which is cemented with iron and silica, is similar to that underlying the Madera and San Joaquin soils. Its thickness appears to range from 6 to 14 inches. Below the hardpan are stratified, weakly consolidated sandy loam and loamy sand of granitic origin.

Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes (GfA).—This well-drained soil lies on gently sloping old alluvial fans and terraces along the Merced and Chowchilla Rivers. In some places it has a mound or hogwallow microrelief. Along the Merced River it is associated with the Snelling soils; along the Chowchilla River, with Madera soils.

Representative profile:

1. The surface soil, to a depth of 18 to 25 inches, is pale-brown, slightly hard, slightly acid sandy loam that becomes light brown and harder with increasing depth. It is granular when moist but massive when dry. It grades into the layer below.
2. This layer, to a depth of 6 to 24 inches, is light yellowish-brown, slightly hard, heavy sandy loam or hard, light sandy clay loam that has a weak, subangular blocky structure. It is slightly acid. It lies unconformably on the layer below. The boundary is abrupt.
3. This layer may be absent, very thin, or, rarely, as much as 4 inches thick. It is brown, nearly neutral sandy clay that tends toward prismatic structure.
4. This is a brown or reddish-brown hardpan 6 to 14 inches thick. It is strongly cemented by silica and iron. The structure in the upper part is slightly laminar.
5. Below the hardpan are deep, stratified sandy loam and loamy sand sediments derived from granitic rocks.

In a few small areas the surface soil is fine sandy loam or loam. In some places the development of the profile above the hardpan is slightly more distinct than that of the profile described.

This soil is moderately deep to deep over hardpan. It is moderately permeable. The available water holding capacity is moderate. Runoff is slow, and there is little or no hazard of erosion. This soil is easy to work, but a plowpan forms if the soil is cultivated when too moist. Fertility is moderate, except for deficiencies of nitrogen, zinc, and sulfur.

About half of this soil is irrigated, about a quarter is used for dryfarmed grain, and the rest is used for range. The sandy loam texture and nearly level slopes make this soil easy to irrigate. Grapes, almonds, and irrigated pasture are grown near Snelling; grain, cotton, and alfalfa on the Chowchilla alluvial fan. Overirrigation should be avoided because it causes a perched water table above the hardpan, and deep-rooted crops may be seriously affected. (Capability unit IIs-3; Storie index rating 67)

Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes (GfB).—This soil occurs only on the terraces along the Merced River. It differs very little from Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes, except that it has stronger slopes and a moderate hazard of erosion. Irrigation should be on the contour so that it will not cause erosion. Most of this soil is in grapes. A few small areas on the south side of the river are used only for range. (Capability unit IIs-3; Storie index rating 57)

Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied (GfB3).—This soil is similar to Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes. It occurs where gullies that originated at terrace escarpments have cut back, usually because of careless irrigation. Gullies of this type may destroy entire fields. Diversion terraces and larger contour checks would prevent excess water from concentrating in minor drainageways and running over the edge of the terrace. Excess water should be disposed of by drop boxes and drainage pipes. (Capability unit IVe-3; Storie index rating 42)

Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes (GeA).—This soil generally develops in depressions where irrigation water and rain water accumulate. Several areas lie northwest of Merced; these areas contain some basic igneous alluvium. The subsoil is slightly mottled. When dry, this soil is harder than Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes.

At least a quarter of this soil is used only for irrigated pasture. A good system of open ditch drains should make the areas more productive. (Capability unit IIIw-2; Storie index rating 44)

Hanford Series

The Hanford soils formed from granitic alluvium on the Merced River bottom land and on the Chowchilla alluvial fan. The alluvium is very recent and shows little evidence of weathering, other than a slightly darker surface color.

These soils are associated with the Grangeville soils, but they have better internal drainage, either because the substrata are coarse textured or because the water table is not high. They are also associated with the Tujunga soils, which are coarse textured and lie mainly in channels and on frequently flooded alluvial fans. The Honcut and Yolo soils have profiles similar to that of the Hanford soils, but the parent alluvium of the Honcut soils was derived from basic igneous rocks and that of the Yolo soils from sedimentary rocks.

These soils consist of pale-brown to light-brown, very friable, moderately coarse textured alluvium more than 6 feet deep. The content of mica is high, and the soil is gritty because of angular grains of quartz and feldspar. In many places the profile is slightly stratified. In a few areas the alluvium is stratified with almost pure washed sand below a depth of 2 feet. Drainage is good. The reaction is neutral.

The original vegetation was a rank growth of grass and weeds and scattered oak, willow, and alder trees.

Hanford sandy loam, 0 to 1 percent slopes (HeA).—This well-drained soil lies on the Merced River bottom land, on the alluvial fan southwest of Hilmar, and on the Chowchilla alluvial fan. The profile consists of only slightly weathered granitic alluvium that is high in mica and quartz. Most areas are nearly level. The areas on the Chowchilla alluvial fan are cut by channels and crossed by streaks of Tujunga sand and are adjacent to

areas of Borden and Madera soils. Near El Nido, this soil occurs as streaks and small fans within areas of Pachappa and Traver soils.

Representative profile:

1. The surface soil, to a depth of 12 to 15 inches, is pale-brown to light-brown, gritty, micaceous sandy loam that has weak, granular structure. It is low in organic matter. The reaction generally is neutral or mildly alkaline. Many cultivated areas have, at a depth of about 8 inches, a faint, slightly compact plowsole about 4 inches thick.
2. This layer consists of yellowish-brown, highly micaceous sandy loam, stratified in places with sandy or silty layers. It is many feet thick.

Included are areas of coarse sandy loam and also areas that have slightly more clay in the subsoil than in the surface layer. Near Ballico, the alluvium along one stream is slightly more reddish and acid than typical.

This soil is very deep. It is rapidly permeable and has a moderate water-holding capacity. Runoff is slow, and there is little hazard of erosion. The soil is easily worked. It is highly fertile except for a deficiency of nitrogen and, in a few places, of zinc or sulfur.

Almost all of this soil is cultivated, except some spots that are inconveniently located. Many kinds of crops are grown. Alfalfa is the principal crop on the Merced River bottom land. There is a slight tendency to over-irrigate because the surface dries out rapidly. Nitrogen fertilizers and manure are used extensively for truck crops and orchard crops. The response is good. (Capability unit I–1; Storie index rating 95)

Hanford gravelly sandy loam, 0 to 1 percent slopes (HdA).—This soil occurs in small areas on the Merced River bottom land near Snelling. It is similar to Hanford sandy loam, 0 to 1 percent slopes, except that it is gravelly throughout the profile, more rapidly permeable, and slightly droughty. Included are a number of small areas that have a gravelly fine sandy loam texture.

This soil is used in much the same manner as Hanford sandy loam, 0 to 1 percent slopes. About half of it is cultivated, and the rest is in small areas of uncleared woodland pasture. Except for old channels in a few places, the gravelly texture is the only restriction on cultivation.

This soil is underlain at considerable depth by gold-bearing gravel. As a consequence, gold-dredgers are rapidly processing what remains of this soil, leaving only piles of gravel. (Capability unit IIs–4; Storie index rating 70)

Hanford fine sandy loam, 0 to 1 percent slopes (HaA).—This soil is similar to Hanford sandy loam, 0 to 1 percent slopes, except that the texture is finer and the color is brown to pale brown. Most of this soil occurs along the Merced River in association with the Grangeville soils. The boundary between the two soils is always gradual. Consequently, many small areas of soils similar to the Grangeville are included in this unit. The moisture-holding capacity is moderate, the soil is easily worked, and the fertility is high.

This soil has practically no limitations for intensive irrigated agriculture. It is easy to irrigate; water can be supplied to most areas either by ditches or by pumps. Nitrogen fertilizer may be added for special crops, such as vegetables or tomatoes, but the supply of plant nutrients is otherwise high. Some undeveloped areas remain in woodland pasture because of the flood hazard. Weeds, particularly johnsongrass, grow lush and rank and interfere with the growth of some crops. (Capability unit I–1; Storie index rating 100)

Hanford fine sandy loam, channeled, 0 to 8 percent slopes (HcB).—This soil is similar to Hanford fine sandy loam, 0 to 1 percent slopes, except that it is cut by numerous channels, 20 to 30 feet deep, that carry water during floods. In many places the channels are close together and have sloping sides; the result is a shallow undulating topography. Some channels have a sandy bottom; in others the soil is wet and mottled like Foster fine sandy loam.

Leveling these areas is expensive, and the flood hazard has prevented any extensive development. Most of this soil is in woodland pasture. Only a small percentage has been cleared and planted to alfalfa. (Capability unit IIe–1; Storie index rating 70)

Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes (HbA).—This soil has formed in fine sand and silt deposited in old channels over beds of washed sand and gravel. The uppermost 2 to 4 feet is like Hanford fine sandy loam, 0 to 1 percent slopes, but, because of the coarse-textured substratum, underdrainage is excessively rapid. Consequently, this soil is droughty, and irrigation is difficult because of excessive loss of water through the soil. Sprinkler irrigation is best. Deep plowing, which would mix the silt with the coarse material and produce a more uniform profile, would make this soil easier to manage.

Very little of this soil is cultivated. Most of it is used only for woodland pasture. (Capability unit IIe–4; Storie index rating 75)

Hilmar Series

The Hilmar soils occur near Hilmar and Stevinson. They adjoin the Delhi soils on the west and southwest. They formed from recent sandy alluvium similar to the parent material of the Delhi soils. The Hilmar soils, however, are poorly drained or imperfectly drained and are more affected by a high water table than the Delhi soils. They appear to be slightly more weathered than the Delhi soils, but the degree of profile development is quite variable. In relief, the two soils are about the same. The Dinuba soils formed from similar but finer textured alluvium.

The Hilmar soils are droughty, wind modified, and sandy. The dominant surface texture is loamy sand, but there are some areas of sand. The calcareous subsoil consists of lenses of sand and silt, some weakly cemented by silica and lime into a hardpan. Saline-alkali spots, where the concentrations of salts and alkali vary from slight to strong, are common in depressions. The vegetative cover is largely saltgrass.

The better drained areas of these soils are used successfully for field crops, but orchards have not proven profitable.

Hilmar loamy sand, 0 to 3 percent slopes (HgA).—This nearly level to undulating soil occurs in broad areas near Hilmar and Stevinson and in smaller areas south of Livingston and Atwater. It is associated with soils of the Delhi series. Drainage is imperfect. Irrigation maintains the water table at a depth of 3 to 6 feet in most areas.

Representative profile:

1. The surface soil is pale-brown to light brownish-gray loamy sand to a depth of 18 to 30 inches. It is loose and single grained. The reaction is neutral to mildly alkaline. The material is micaceous and obviously derived from granite.
2. The substratum, to a depth of 4 feet or more, consists of mottled, light-gray silt loam or very fine sandy loam that is stratified and, in places, platy. It occurs in lenses, lumps, and strata interlain by sands. Seams and nodules of segregated lime are visible in the lower layers. Some areas have a thin hardpan cemented with silica and lime.
3. The material below a depth of 4 feet is less calcareous with increasing depth. The depth to the water table is generally 3 to 6 feet. The sandy and silty layers continue, much the same, for many feet.

In a few spots the surface layer is very thin and the light-gray substratum material has been brought to the surface by plowing. Some areas of loamy fine sand are included.

This soil is moderately deep. Permeability is very rapid in the surface soil and slow to very slow in the subsoil. Surface runoff is very slow. There is no hazard of water erosion but a moderate hazard of wind erosion. The water-holding capacity is low. Fertility is moderate. The supply of nitrogen is low, and additional zinc and sulfur are needed for some crops.

Most of this soil has been cleared and leveled. Irrigated alfalfa, grapes, sweetpotatoes, and pasture are the common crops.

Because of wind erosion, the coarse texture, and low moisture-holding capacity of the soil, establishing seedlings is sometimes difficult. Large heads and short runs are necessary to prevent overirrigation. Where leveling cuts have been made into the substratum, the water may penetrate irregularly. Nitrogen fertilizers and manure bring good response, and phosphate and sulfur may benefit alfalfa. Where the water table is high, drainage systems may be useful, but to be effective they usually need to be large community projects. Drainage pumps are used to good effect in some places. Rotation of crops is practiced irregularly. To control wind erosion, practices such as stripcropping, establishing of windbreaks, and planting at right angles to the prevailing winds are advisable. (Capability unit IIIw-4; Storie index rating 69)

Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes (HhA).—This soil is similar to Hilmar loamy sand, 0 to 3 percent slopes, except that it is slightly saline-alkali. The salts are generally in the subsoil, but in some places they are in the subsurface layer just below the dry zone. Included are areas of fine sand or loamy fine sand and areas where the loamy sand has been blown over older Fresno soils, which have a strongly cemented lime-silica hardpan.

Much of this soil is used only as saltgrass range. Crops are limited to alfalfa, irrigated pasture, and a few field crops. Evidence of difficult farming operations is common. (Capability unit IIIw-4; Storie index rating 48)

Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes (HfA).—This poorly drained soil differs from Hilmar loamy sand, 0 to 3 percent slopes, in that it is distinctly mottled with strong-brown stains in the subsoil and in many places with bluish stains in the surface soil. Its water table is higher. It has a slightly compact, mottled, gray upper subsoil at about 18 inches. Layers cemented with lime and silica are more common in the deeper subsoil.

The poor drainage and the content of salts and alkali make this soil unsuitable for most cultivated crops, but irrigated pasture can be grown. Drainage ditches or pumps to lower the water table would improve drainage and remove some of the salts and alkali, but to be successful, reclamation should probably be a community-wide project that would result in lowering the water table permanently over a wide area. (Capability unit IVw-4; Storie index rating 28)

Hilmar sand, 0 to 3 percent slopes (HoA).—This soil occurs mainly near Hilmar and Stevinson and eastward toward Livingston. It is associated with the Delhi soils. This soil is like the more extensive Hilmar loamy sand, 0 to 3 percent slopes, except that the surface soil is coarser textured and lighter colored. It is imperfectly drained and has small saline-alkali spots. It is subject to wind erosion. The water-holding capacity is very low. The depth to the silty substratum ranges from 18 to more than 40 inches. The lime accumulation in the subsoil ranges from a slight concentration of segregated lime to a thin, firmly cemented, lime-silica hardpan in some places. The vegetation generally consists of saltgrass.

Included are areas of fine sand and areas in which the profile is similar to that of Delhi sand, except for having a hardpan.

The sandy surface texture, the high water table, and the lime in the subsoil limit the selection of crops. Peaches and almonds do poorly; grapes do fairly well; the most profitable crops appear to be alfalfa, irrigated pasture, melons, and sweetpotatoes. Dairying is the principal farm enterprise.

The sandy surface soil blows readily. Windbreaks, stripcropping, and planting at right angles to the prevailing wind are advisable.

About 75 percent of this soil has been developed for irrigation, but at least a third of the irrigated area is idle every year. Irrigated pastures are extensive. Irrigation in excess of the moisture-holding capacity is common; this adds to the high water table, which is detrimental to deeper rooted crops. (Capability unit IIIw-4; Storie index rating 43)

Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes (HpA).—This soil occurs in low spots and in broad areas near Stevinson and small areas near Hilmar. The subsoil contains weak concentrations of salt. A thin zone of salt concentration is common at the surface of the moist zone, which ranges from 6 to 18 inches below the surface. The water table is usually at a depth of 3 to 5 feet. Some areas have a surface texture of fine sand, and in places the subsoil is noncalcareous.

Deep-rooted crops, other than alfalfa, cannot be grown successfully. Irrigated pasture is profitable if water is available and irrigation not too expensive. Large areas are used only for saltgrass pasture. Many areas have been abandoned. Milo and silage corn are grown to some extent in connection with dairying. (Capability unit IIIw-4; Storie index rating 33)

Hilmar sand, poorly drained, 0 to 1 percent slopes (HkA).—This soil occupies nearly level areas or depressions where the water table is usually within 12 to 18 inches of the surface. The profile is similar to that of Hilmar loamy sand, 0 to 3 percent slopes, except that it is coarser textured and has bluish mottling. Some areas of loamy

sand and loamy fine sand are included. One small area has a very thin surface soil.

Most of these areas are uncultivated and are used only for pasture. Unless the water table can be generally lowered over a broad area, there is little prospect of using this soil for anything but improved pasture. (Capability unit IVw–4; Storie index rating 32)

Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes (HmA).—This soil is similar to Hilmar sand, poorly drained, 0 to 1 percent slopes. It occupies depressions and sandy playas that are swampy or intermittently ponded. Moderate amounts of salts and alkali in the immediate surface layer form salt crusts and cause brown or brownish-black organic stains.

No crops are grown. The vegetation is saltgrass and alkali weeds, which furnish some forage. (Capability unit VIw–4; Storie index rating 10)

Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes (HnA).—This soil occurs in poorly drained areas where strong concentrations of salts and alkali have accumulated. The surface is nearly covered by salt crusts and ponds of brown, foul, stagnant water.

The better spots have some saltgrass that can be grazed, but most of this soil has little natural growth and is poorly suited to agriculture unless improved. (Capability unit VIw–4; Storie index rating 3)

Honcut Series

The Honcut soils lie along Bear, Burns, and Mariposa Creeks near Merced, Planada, and Le Grand, and along Dry Creek in the northern part of the Area. They generally lie on low ridges parallel to the stream or on small, generally well-drained fans of smooth relief. The parent material was recently deposited alluvium derived from various sources, mostly basic igneous rocks.

The Honcut soils show little change from the original alluvium, other than a slightly darker, reddish surface soil. Where this kind of alluvium has been weathered for some time, the Wyman soils, which have slightly more clay in the subsoil than in the surface soil, have formed. Where drainage is imperfect, the darker colored Burchell soils have formed. Very old alluvium of this kind has been weathered to form the Ryer and Yokohl soils.

The profile consists of friable, porous, moderately coarse textured to moderately fine textured alluvium that extends to a considerable depth. In some places the profile is underlain at a depth of 4 to 6 feet by a dense substratum similar to the Yokohl hardpan. The color is brown (nearly reddish brown) and in the surface soil becomes a little lighter with increasing depth. The reaction is generally neutral, but a little lime may be present in the subsoil where internal drainage is restricted by a hardpan substratum or other hindrance. These soils are hard when dry and slightly sticky when wet. The profile generally contains a high percentage of very fine sand and silt. The vegetation consists of grass and large scattered oak trees.

Honcut silt loam, 0 to 1 percent slopes (HtA).—This well-drained, nearly level soil occurs mainly on the alluvial fans of Bear and Mariposa Creeks near Merced and Le Grand and along Dry Creek in the northern part of the Area. It consists of deep deposits of brown, silty alluvium.

Representative profile:

1. The surface layer, to a depth of 18 to 24 inches, is brown (almost reddish-brown), friable, granular silt loam. The reaction is nearly neutral. There are many roots and insect holes. This layer grades into the next one.
2. This layer is made up of brown, stratified silt loam and loam. It is friable and essentially massive. The reaction is about neutral. In places, where the soil grades into nearby soils that have restricted subdrainage, there is a little mottling or lime in the subsoil below a depth of about 4 feet.

Included are areas of very fine sandy loam and loam, and a few areas that have a distinctly calcareous subsoil.

This soil is high in fertility, except that it needs nitrogen. It has a high water-holding capacity. Surface runoff is very slow, and there is no erosion hazard.

This is one of the most highly prized soils in the Area for truck crops and orchards. Good to high yields of most fruits, almonds, tomatoes, and other vegetables can be obtained under proper management. A few hundred acres are still used for dryfarmed grain. Only a few small, inconveniently located areas remain undeveloped.

This soil is easy to work, but it puddles and forms dense clods when worked too wet. It is moderately permeable under natural conditions; however, in most cultivated fields under irrigation, a dense plowsole develops at a depth of 8 to 12 inches. This layer, in many places 6 to 8 inches thick, restricts moisture and air penetration enough to lower the productivity of the soil considerably. Using large tractors and disks too soon after irrigation is mainly responsible for this condition. The best remedies for a plowsole of this type are to (1) avoid cultivation when the surface foot of soil is moist enough to shine when turned with a disk, (2) cultivate no more than necessary (control weeds by sprays), (3) permit the soil to dry out completely to below the plowsole layer, and (4) grow vigorously rooting cover crops, such as alfalfa. (Capability unit I–1; Storie index rating 100)

Honcut silt loam, deep over hardpan, 0 to 1 percent slopes (HuA).—This soil formed in material deposited recently over areas of older Yokohl hardpan soils. A crumbly or very hard and dense hardpan lies at a depth of 4 to 5 feet. In most places the transition is abrupt. The silt loam just above the hardpan is mottled in most places because water stands periodically above the hardpan. In general this layer is slightly calcareous, and the surface of the hardpan may be encrusted with lime.

Most of the crops grown on Honcut silt loam, 0 to 1 percent slopes, are grown on this soil. Yields of deep-rooted crops are often noticeably lower. This may be partly because overirrigation is rather common, as the subsoil contains more moisture than is readily apparent. Using a probe to follow the progress of moisture penetration during irrigation and checking the subsoil moisture with a soil auger before irrigation are essential to the proper management of this soil. (Capability unit IIs–3; Storie index rating 80)

Honcut fine sandy loam, 0 to 1 percent slopes (HrA).—Most of this soil is northwest of Planada along Bear Creek. It is similar to Honcut silt loam, 0 to 1 percent slopes, except that it is coarser textured and slightly stratified with sandy layers throughout the profile. It has less tendency to puddle and break into dense clods, and plowsoles are less dense and less common. The water-holding capacity is moderate.

Included are areas of sandy loam, a few areas that have a subsoil similar to that of the Wyman series, and a few small areas that are slightly calcareous in the lower subsoil, probably due to locally restricted drainage.

This soil is of high agricultural value. It produces good yields of a wide range of crops. All but a few inaccessible spots are cultivated. Yields of alfalfa, truck crops, and orchard crops are high. (Capability unit I–1; Storie index rating 100)

Honcut gravelly sandy loam, 0 to 1 percent slopes (HsA).—This soil, of limited extent, lies close to the banks of Bear and Dry Creeks. The profile is gravelly sandy loam, uniform throughout except in places where gravel beds occur in the deeper part. The gravel interferes somewhat with cultivation, and only a few of the larger areas are cultivated. The water-holding capacity is moderately low. Yields of alfalfa and fruit are fairly good under irrigation, and dryfarmed grain also does well. (Capability unit IIs–4; Storie index rating 70)

Honcut silty clay loam, 0 to 1 percent slopes (HwA).—This soil is similar to Honcut silt loam, 0 to 1 percent slopes, except that it has finer texture, a slightly stronger brown color, and strong tendencies to puddle and to form a plowsole when worked too wet.

Most of this soil is nearly level and easy to irrigate. It will produce high yields when properly managed. Nearly all of it is under irrigation. It is particularly well suited to figs, cotton, milo, and irrigated pasture and also produces peaches, tomatoes, and alfalfa. Sugar beets should yield well. Peach yields are not so great as on the coarser textured soils. Irrigation by furrows and long checks can be used very successfully. The moisture-holding capacity is high, but water penetration is usually moderately slow, because of the plowsole that generally forms under cultivation. All crops except irrigated pasture should be irrigated only occasionally; two to four irrigations per year are enough for deep-rooted crops. Some gypsum is occasionally applied in an attempt to improve the cloddy tilth that forms when the soil is puddled. Physical improvement is scant unless careful soil management practices are followed. Particular care should be used to avoid working this soil when it is too moist. (Capability unit I–1; Storie index rating 90)

Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes (HxA).—Except for texture, this soil is similar to Honcut silt loam, deep over hardpan, 0 to 1 percent slopes. The same problem of a perched water table in the lower subsoil develops if this soil is over-irrigated.

Almost all of this soil is irrigated. The principal crops are figs, field crops, and irrigated pasture. Peaches are grown, but yields are not high. (Capability unit IIs–3; Storie index rating 72)

Honcut silty clay loam, channeled, 0 to 8 percent slopes (HzA).—This soil consists of large overflow channels that have been smoothed down somewhat. They appear as a narrow undulating band in the otherwise level areas of Honcut soils. These areas interfere somewhat with irrigation. In many places there is a strip of imperfectly drained soil in the lowest part of the channel. Otherwise, this soil is similar to Honcut silty clay loam, 0 to 1 percent slopes, and the crops grown are usually the same. Irrigation must be managed carefully, to avoid waterlogging and bringing down yields in the lowest parts of these areas. (Capability unit IIe–1; Storie index rating 65)

Hopeton Series

The smooth, well-drained, brown Hopeton soils are on slopes below the high, gravelly terraces. The parent material consisted of yellowish-brown to yellowish-red sediments compacted into a moderately consolidated, clayey sandstone. Apparently the sediments weathered from outcrops of a stratum between the andesitic tuff from which the Pentz and Peters soils were derived and the higher lying gravel from which the Redding soils developed. The clay in the Hopeton soils suggests that the andesitic tuff contributed some of the parent material. The position of these soils suggests that the parent material was deposited very long ago and that the capping of gravel was stripped off much later.

The Hopeton soils show evidence of strong weathering. A distinct reddish-brown claypan has formed in the subsoil. Gravel and cobblestones occur in places but only in the surface soil. Mound microrelief, which is common in nearby soils, is lacking. The vegetation consists of wild oats, alfileria, soft chess, and burclover.

The Hopeton soils are distinguished from the Corning soils by a less gravelly profile and by a little lime or an alkaline reaction in the lower part of the subsoil. In some areas these soils grade into the dark-colored, clayey Raynor soils and the reddish-brown, clayey Porterville soils.

Hopeton clay loam, 0 to 3 percent slopes (3HA).—This soil is associated with the Redding and Corning soils on the slopes of dissected terraces below the Redding gravel beds. The largest areas are near Yosemite Lake, but smaller areas are scattered among the high terraces.

This soil is brown to reddish brown and can be distinguished from the gray Raynor and Peters clays by its color. It differs from the Redding and Corning soils in lacking mound microrelief and containing less gravel.

Representative profile:

1. The surface soil, to a depth of 6 to 20 inches, is brown to reddish-brown, hard clay loam that has weak, medium, blocky structure. Some organic films coat the blocks. This layer is slightly acid. It is moderately low in organic matter. In many places it contains pockets of cobblestones or gravel. The lower boundary is abrupt.
2. This layer is made up of a reddish-brown to brownish-red, hard, strong, blocky clay that is very plastic when wet. It contains few roots and little organic matter. The reaction is mildly alkaline. Some places have tiny, hard pellets of lime that effervesce with acid only after being slightly crushed. The lower boundary is abrupt in places.
3. At a depth of 24 to 36 inches is strong-brown or yellowish-brown, friable clay loam to heavy sandy loam. It is intermittently calcareous and mildly alkaline. It is moderately consolidated; the lower, less weathered part resembles a soft sandstone. This material extends to considerable depth.

Included are a number of areas that have a loam surface layer. Where this soil adjoins areas of gray soils, the color grades to grayish brown.

The surface soil is moderately permeable; the subsoil is very slowly permeable. Surface runoff is slow. There is a very slight erosion hazard. The water-holding capacity is low. The soil is deficient in nitrogen and phosphorus and possibly in minor elements.

This soil is used mainly for range. A few acres are used for irrigated pasture. Wild oats and burclover produce

better feed on these soils than on the adjoining areas of Redding and Corning soils. This soil could be cultivated, but yields would be low because of the shallow root zone and the deficiency of nitrogen and phosphorus. Trampling by livestock in wet weather puddles the surface. The surface slicks over irregularly when wet; therefore, penetration of water is erratic. (Capability unit IVs-3; Storie index rating 48)

Hopeton clay loam, 3 to 8 percent slopes (3HB).—Except for slope, this soil is similar to Hopeton clay loam, 0 to 3 percent slopes. Runoff is medium, and there is a slight erosion hazard.

This soil is used mainly for range. It provides good feed for cattle for a short time in winter and spring. The stock prefer these areas; they often graze them almost bare before they graze areas where the soil is more acid and leached and the forage is of lower quality. (Capability unit IVe-3; Storie index rating 45)

Hopeton clay loam, 8 to 15 percent slopes (3HC).—The surface layer of this soil is a little thinner than that of Hopeton clay loam, 0 to 3 percent slopes, because of more rapid runoff and slight erosion. Although these areas are heavily grazed, they show little evidence of erosion. Gullies and rills are very rare.

This soil is not extensive. It is used only for range. (Capability unit IVe-3; Storie index rating 38)

Hopeton gravelly clay loam, 0 to 8 percent slopes (4HB).—This soil has enough gravel and cobblestones on the surface to interfere with cultivation. It is used for range, probably its best use. (Capability unit IVe-3; Storie index rating 38)

Hopeton clay, 0 to 8 percent slopes (2HB).—This soil is similar to Hopeton clay loam, 0 to 3 percent slopes, except that it has a clay surface layer and a slightly more calcareous subsoil. When the soil dries, large cracks form in the surface layer. In a few places, secondary cracking results in a fine granular structure similar to that of the Porterville soils. Some areas have a little gravel and a few scattered cobblestones in the surface layer only.

This soil is difficult to work because it is clayey and contains a few cobblestones. With favorable rainfall, it produces a thick growth of burclover, on which livestock thrive. (Capability unit IIIs-5; Storie index rating 25)

Hornitos Series

The Hornitos soils, formed from marine sandstones, occur in scattered spots along the western edge of the Sierra Nevada foothills. The terrain is rolling and there are scattered flat-topped buttes and numerous rock outcrops. The parent material was laid down as a shoreline deposit. It consisted of very old sediments derived from a land surface subject to intensive weathering and very slow erosion. The sediments were strongly weathered before the Hornitos soils began to form. The sandstone is made up chiefly of quartz and other stable minerals that are resistant to chemical change; consequently, these soils are shallow and infertile.

The Hornitos soils are associated with the Amador soils, which formed from rhyolitic tuff, and with the Daulton and Whiterock soils, which formed from Mariposa slate.

The profile is generally less than 10 inches deep. The color ranges from pale brown to reddish yellow, depending upon the color of the sandstone. The reaction is strongly acid. Drainage is good to somewhat excessive. The vegetation is grass and scattered oaks.

The colorful sandstone is quarried in several places in the Area and used for building stone.

Hornitos fine sandy loam, 3 to 8 percent slopes (5HB).—This undulating soil lies mainly in swales and saddles between the higher buttes. Mound, or hogwallow, microrelief is very prominent. Some mounds are as much as 8 feet high and have slopes of as much as 45 percent. Burrows and mounds of pocket gophers are everywhere in great profusion and may cover 10 to 20 percent of the surface.

Representative profile:

1. The surface layer, to a depth of 4 to 14 inches, is pale-brown to light reddish-brown fine sandy loam. It has weak, granular structure when moist and is essentially massive when dry. It is strongly acid and low in organic matter. In many areas a little quartz gravel is present, mostly on the surface. The lower boundary is rather abrupt.
2. The parent material is banded, pale-yellow or reddish-brown, weathered sandstone. It is strongly acid to very strongly acid. Unweathered sandstone is within 2 or 3 feet of the surface in most places. The depth of the profile depends largely upon the hardness of the sandstone, which varies considerably.

Small areas of Amador soils are included in this unit. There are small areas of rock outcrops.

This soil is moderately permeable. Surface runoff is medium, and the erosion hazard is moderate. The water-holding capacity is very low. The soil is shallow to very shallow. Fertility is low. None of this soil is cultivated. It would be difficult to work because of the scattered rock outcrops. It is all in winter and spring range of low quality. (Capability unit VIIe-9; Storie index rating 11)

Hornitos fine sandy loam, 8 to 30 percent slopes (5HD).—This soil is located on the buttes and in generally hilly areas. It is very shallow. The mounds are generally lower and less distinct than those on Hornitos fine sandy loam, 3 to 8 percent slopes.

This soil shows little evidence of accelerated erosion, but the thin concentration of white quartz gravel on the surface in many places indicates that some geologic erosion is going on. The hazard of further erosion is severe. This soil is used only for winter and spring range. It produces fair to poor feed. (Capability unit VIIe-9; Storie index rating 9)

Hornitos fine sandy loam, 30 to 45 percent slopes (5HE).—This soil is generally only a few inches deep. It has an even more severe hazard of erosion than Hornitos fine sandy loam, 8 to 30 percent slopes. It occurs on the higher buttes and in areas cut sharply by small streams. Small areas of rills and areas barren of vegetation are evidence of erosion. Rock outcrops are common.

This soil is used for range. To maintain the grass, livestock should be rotated from field to field and their numbers limited to the carrying capacity of the range. (Capability unit VIIe-9; Storie index rating 8)

Hornitos gravelly fine sandy loam, 0 to 8 percent slopes (6HB).—This soil is similar to Hornitos fine sandy loam, 3 to 8 percent slopes, but its parent sandstone contained considerable gravel, much of it derived from dikes of white quartz rock. In some places the sandstone grades into conglomerate made up of cemented gravel.

Even the deepest areas of this soil are unsuitable for cultivation. The amount of feed produced is slightly less than on Hornitos fine sandy loam, 3 to 8 percent slopes. (Capability unit VIIe–9; Storie index rating 8)

Hornitos gravelly fine sandy loam, 8 to 30 percent slopes (6HD).—This soil has large quantities of white quartz gravel on the surface and throughout the profile. Rock outcrops and areas almost bare of soil material are numerous. In places the soil shows evidence of a little sheet and rill erosion. (Capability unit VIIe–9; Storie index rating 6)

Keyes Series

The Keyes soils are on the gravelly high terraces. They are undulating to rolling and have a distinct mound microrelief. The parent material is gravelly, mixed, igneous alluvium, mainly from andesitic rocks. The gravel is rounded and consists mostly of andesite, quartzite, and aplite. These soils have been weathering for a long time, and an indurated, conglomeratelike hardpan has formed.

The Keyes soils are associated with the Redding, Corning, and Pentz soils. They are similar to the Redding soils, except that the color is darker and the parent material contains more andesitic material. As the gravel beds thin out over the beds of andesitic tuff, the Keyes soils grade into soils of the Pentz and Peters series. The vegetation is mainly alfileria and annual grasses.

The profile of the Keyes soils is almost identical to that of the Redding soils in all characteristics except color and reaction. The surface soil is grayish brown or dark grayish brown. The claypan subsoil is grayish brown and, in places, faintly mottled. The Keyes soils are slightly acid to medium acid, whereas the Redding soils are medium acid to strongly acid. The cemented gravelly hardpan is just as dense and impervious as that in the Redding soil, but is yellowish brown in color. In some places the hardpan rests directly upon a substratum of andesitic tuff, but more commonly it is separated from it by a gravelly layer.

Keyes gravelly loam, 0 to 8 percent slopes (KbB).—Most of this soil lies on the high terraces. It is associated with Redding, Corning, Pentz, Peters, and Raynor soils. The topography is gently sloping to undulating. In most places it has a microrelief of low mounds.

Representative profile:

1. The surface soil, to a depth of 12 to 15 inches, is slightly acid to medium acid, grayish-brown to dark grayish-brown gravelly loam that normally becomes browner and more clayey in the lower part. The uppermost inch or two has weak, platy structure; the lower part is essentially massive when dry. There are many cobblestones in this layer, in addition to the gravel. The content of organic matter is moderately low.
2. This layer is a very hard, grayish-brown clay that has strong, medium blocky structure. It is only a few inches thick in most places. In many places it is faintly mottled. The blocks are coated with fine clay films. The reaction is medium acid. Some cobblestones and gravel are firmly imbedded in the clay.
3. The hardpan is 4 to 12 inches thick. It consists of an indurated mass of gravel and cobblestones cemented together by yellowish-brown, brittle material which in some places is coated with purplish-black manganese stains. Below the cemented layer there is looser gravel and, at a depth of 3 to many feet, soft andesitic tuff.

Included are areas of gravelly sandy loam. This soil is well drained and has slow surface runoff. The fertility and water-holding capacity are low. The clay layer and the hardpan are almost impermeable to roots, and the root zone is confined to the surface layer. The soil is difficult to work because of the gravel and cobblestones.

This soil is poorly suited to intensive agriculture. Only a few spots are cultivated. This soil is a little more fertile than the Redding and Corning soils, but it has serious deficiencies of nitrogen and phosphorus. It is used almost entirely for winter and spring range. It produces fair yields of grass and alfileria. (Capability unit IVe–3; Storie index rating 9)

Keyes gravelly loam, 8 to 15 percent slopes (KbC).—This soil is similar to Keyes gravelly loam, 0 to 8 percent slopes, but it is more cobbly and has mound microrelief in only a few places. Runoff is medium, but there is little evidence of erosion even where grazing is heavy. This soil is used entirely for range. (Capability unit VIe–9; Storie index rating 8)

Keyes gravelly clay loam, 0 to 8 percent slopes (KaB).—This soil has a slightly higher moisture-holding capacity than Keyes gravelly loam, 0 to 8 percent slopes, and a less evident mound microrelief. It has a tendency to puddle when trampled by livestock after a rain. Where this soil borders on Pentz clay loam, the two are sometimes difficult to distinguish.

This soil is used for range. It produces a little better grass than Keyes gravelly loam, 0 to 8 percent slopes. (Capability unit IVe–3; Storie index rating 9)

Keyes-Pentz gravelly loams, 0 to 8 percent slopes (KcB).—This complex occurs where part of the gravel capping of the soils has been eroded away in small drainageways. The result is an intricate pattern of strongly weathered Keyes soils intermingled with the more recently exposed shallow Pentz soils, which weathered directly from andesitic tuff. The texture ranges from gravelly loam to clay loam within short distances. Included in this complex are small areas, redder in color, of Redding or Corning soils. Small spots of Peters clay are also included.

This complex is used only for range. It produces about the same amount of forage as Keyes gravelly loam, 0 to 8 percent slopes. (Capability unit VIe–9; Storie index rating 9)

Landlow Series

The Landlow soils extend from near Lingard on the Southern Pacific Railroad westward along Owens Creek, Miles Creek, and Duck Slough. They formed from moderately fine textured alluvium of mixed origin but mainly from basic igneous rocks. They are nearly level. Drainage is imperfect. The water table normally is within 4 feet of the surface. Before these soils were cultivated, they were intermittently ponded or swampy, and they supported a heavy growth of grass and rushes.

These soils are only slightly weathered. Only a slight amount of clay has accumulated in the subsoil, and the lower subsoil is weakly cemented with lime. The associated Burchell soils have less clay in their subsoil and lack the weakly lime-cemented lower subsoil. Where considerable amounts of salts and alkali have accumulated, the Lewis soils have formed. Toward the east,

where drainage is better, the Landlow soils grade into the Yokohl soils.

The profile generally consists of a dark-gray to dark grayish-brown silty clay loam or clay surface soil with a blocky (adobe) structure. The reaction is about neutral in the surface soil but becomes mildly to moderately alkaline with increasing depth. Generally, the surface soil is very hard when dry and very sticky when wet, but where the texture contains more silt, the consistence is softer and less sticky.

Many areas of these soils are used for growing rice. Where rice has been grown for some time, the surface soil is puddled and difficult to work and is distinctly mottled with strong-brown stains. The stains remain for many years after the growing of rice has been abandoned.

Landlow silty clay loam, 0 to 1 percent slopes (LeA).—This is a dark-colored, imperfectly drained soil. At a depth of 30 to 40 inches, it has a weakly lime-cemented hardpan, which may be hard or rather nodular.

Representative profile:

1. The surface soil, to a depth of 10 to 14 inches, is dark grayish-brown to dark-gray, neutral silty clay loam that has moderate, coarse, blocky structure. It is moderately high in organic matter. It is generally noncalcareous. It is hard when dry, friable when moist, but sticky and very plastic when wet. The surface soil grades into the upper subsoil.
2. The upper part of the subsoil is dark grayish-brown to dark-brown clay that has moderate, medium, blocky structure. This grades into mottled, moderately calcareous clay that has weak, blocky structure. This layer is very sticky and very plastic when wet. It is 20 to 30 inches thick. The lower boundary is abrupt.
3. The hardpan is pale-brown, mottled, nodular to weakly lime-cemented clay. It occurs at a depth of 30 to 40 inches and generally is 8 to 12 inches thick. A perched water table often forms above it.
4. Below the hardpan and extending to a considerable depth are moderately calcareous, stratified, moderately fine textured sediments, generally with gray mottles that dry to light brownish gray. This material is almost always saturated because the water table is usually near the level of the hardpan.

In places the surface soil is clay loam. In areas used for rice, the uppermost 12 inches is mottled. In some areas dark-colored soil material has been recently laid down over an older soil profile.

Runoff is ponded to very slow. The water table is usually within 4 feet of the surface. The water-holding capacity and fertility are high. This soil is moderately difficult to work because it is friable only through a narrow range of moisture content. The upper part is slowly permeable, and the hardpan is very slowly permeable.

This soil is used mostly for irrigated pasture. Smaller areas are used for rice, grain, alfalfa, other field crops, and figs. The moderately fine texture and the high water table limit this soil mainly to shallow-rooted crops.

The high water table is maintained partly by irrigation and partly by seepage from the small creeks nearby. On all crops except figs, irrigation water is applied lavishly without regard to the water table. A system of drainage ditches might successfully drain this soil so it could be used for a wider range of crops.

This soil puddles very easily; it should never be cultivated when wet. Where rice is grown, the surface becomes puddled, cloddy, and very slowly permeable to air and water. (Capability unit IIIw-2; Storie index rating 43)

Figure 12.—**Landlow clay, 0 to 1 percent slopes, that has been plowed when too moist. The soil puddles severely, and plowing produces large clods.**

Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes (LfA).—This soil has slight concentrations of salts and alkali in the subsoil or in the subsurface layer. If drainage can be established, the salts and alkali can be removed by growing irrigated pasture or rice.

This soil puddles very readily when worked too moist, as in a rice paddy. Gypsum has been used to improve the cloddy surface structure, but with little success. Rice yields well, but stands of alfalfa are spotty. Grain can be grown with moderate success, with or without pre-irrigation.

Included are soils of similar profile but slightly browner color and some soils that appear to have been recently deposited over older hardpan soils of the Lewis series. (Capability unit IIIw-6; Storie index rating 30)

Landlow silt loam, 0 to 1 percent slopes (LcA).—This soil is similar to Landlow silty clay loam, 0 to 1 percent slopes, except that a thin deposit of silt loam has been fairly recently added to the surface. The two soils can be managed in much the same way, but the less sticky silt loam is easier to work, and yields are slightly higher. (Capability unit IIIw-2; Storie index rating 48)

Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes (LdA).—This soil is similar to Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes, except that its surface layer is silt loam which is easier to work. (Capability unit IIIw-6; Storie index rating 34)

Landlow clay, 0 to 1 percent slopes (LaA).—This soil is similar to Landlow silty clay loam, 0 to 1 percent slopes, but is slightly darker colored in some places. It is located in the same general area. It is difficult to cultivate because it is friable only within an extremely narrow range of moisture content. Included with this soil are some areas that have little or no lime cementation in the lower subsoil, and other areas in which the soil is brown instead of grayish.

Most of this soil is used for rice, irrigated pasture, and range. A few areas are used for cotton, grain, and alfalfa. Where rice is grown, the surface soil puddles badly. After it dries, the soil breaks into large, hard, dense clods when it is worked (fig. 12). Soil formerly used for rice has distinct yellowish-brown and rust-colored

mottles in the surface soil. (Capability unit IIIw–5; Storie index rating 29)

Landlow clay, slightly saline-alkali, 0 to 1 percent slopes (LbA).—This soil is similar in use soil management to Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes, but it is more difficult to work, has a very slowly permeable surface layer, and would be more difficult to reclaim. (Capability unit IIIw–5; Storie index rating 20)

Lewis Series

The Lewis soils occur extensively in the saline-alkali basin. They are hardpan soils that developed from mixed alluvium washed from sedimentary, basic igneous, and granitic rocks. They are nearly level but have a low mound microrelief. They have very slow drainage, both internally and externally, and have been affected by a high water table. The vegetation consists of saltgrass and other alkali-tolerant grasses and plants.

These soils are strongly weathered and have a distinct profile. Where they are next to areas of granitic alluvium, they grade imperceptibly into soils of the Fresno and Traver series. Toward the east they grade into the better drained Yokohl and Madera soils. Where flooding has been frequent enough to remove some of the excess salts, the Burchell and Landlow soils have developed. In position and manner of formation, the Lewis soils are similar to the Fresno soils, but they formed from a different kind of parent material.

The Lewis soils have a lime-silica cemented hardpan at a depth of about 30 to 40 inches, and they contain slight, moderate, or strong concentrations of salts and alkali. The pale-brown surface soil ranges from loam to clay. In many places a very thin layer of fine sandy loam lies on the immediate surface. The surface soil is hard and has a blocky structure and a strongly alkaline reaction. The salt content ranges from slight to strong in this layer. The upper subsoil is finer textured than the surface soil. In most areas it is grayish brown. It contains more salts and alkali than the surface layer, as well as masses of segregated lime. The lower subsoil is fine textured, and the blocky aggregates are smaller and become less distinct with increasing depth. The content of segregated and nodular lime increases with depth. The texture of the subsoil is generally clay, grading to heavy clay above the hardpan. The boundary between the lower subsoil and the hardpan is commonly very abrupt. A mat of saltgrass roots lies directly on the surface of the hardpan in some places. The hardpan itself ranges from very hard to nodular within short distances. The structure of the hardpan is ordinarily laminar, and the thickness is generally about 4 inches, although it ranges from 1 to 12 inches. Below the pan the texture ranges from clay loam to sandy loam, and the soil is mottled brown or olive brown in color. Below the hardpan, the amount of segregated lime decreases, and the concentration of soluble salts is usually slight.

Lewis loam, slightly saline-alkali, 0 to 1 percent slopes (LkA).—This imperfectly drained soil is moderately deep over a hardpan. It is on the northern and eastern sides of the saline-alkali basin area south of Merced and extends from the Southern Pacific Railroad almost to the San Joaquin River flood plain.

Representative profile:

1. The surface soil, to a depth of about 3 inches, is pale-brown, vesicular, slightly calcareous fine sandy loam or loam. There is an abrupt transition to grayish-brown, strongly alkaline, moderately calcareous clay loam that has strong, medium, prismatic or columnar structure. The clay loam is very hard when dry, firm when moist, and sticky or very plastic when wet. It extends to a depth of 12 to 14 inches, and grades into the next layer.
2. This layer is brown, strongly calcareous clay. It contains lime nodules that increase markedly in number in the lower part. It is very hard when dry and very sticky and plastic when wet. It is softer and more friable in the lower part. This layer extends to a depth of 30 to 40 inches. The lower boundary is abrupt.
3. The hardpan is brown, impermeable, and weakly cemented by lime and silica. It ranges from very hard to nodular. It is 3 to 8 inches thick.
4. Below the hardpan are brown to olive-brown, firm, calcareous sediments of clay loam to sandy loam texture. They contain some hard lime nodules.

Included are areas that have a silt loam surface soil, and a few small areas where recent alluvium has been added to the surface.

This soil is moderately permeable in the uppermost few inches, but it is very slowly permeable below. It is easy to work, but it puddles badly if cultivated when too moist. Fertility is moderate, but the phosphorus is not in a form readily available to plants. Runoff is very slow to ponded. There is little or no hazard of erosion. The water-holding capacity is low.

In this soil, the salts and alkali generally occur in spots, and the concentrations are weak enough to permit germination of salt-tolerant crops over much of the area. Uncultivated areas generally have a good stand of saltgrass and other grasses, such as foxtail and brome, which make fairly good range pasture. About half of this soil is used only for range. The remainder is mainly in rice and irrigated pasture, and there are a few fields of grain and other crops.

Where row crops are grown, it is common practice to set up border checks, plant the crop between checks, and irrigate by flooding. This is more satisfactory than furrow irrigation, which tends to accumulate toxic quantities of salts in the furrow ridges. It is best to keep the soil moist throughout the growing season, as the salts tend to become more concentrated as the soil dries. Where rice is grown, the salts are slowly leached into the drainage ditches, and, except for the extremely puddled surface, the soil is then reasonably workable. (Capability unit IIIs–8; Storie index rating 25)

Lewis loam, moderately saline-alkali, 0 to 1 percent slopes (LmA).—This soil is moderately affected by salts and alkali. Salt crusts and small barren areas somewhat eroded by wind are common.

Crops cannot be grown successfully without expensive and difficult reclamation, which generally requires extensive flooding and the application of gypsum or sulfur. Growing rice or irrigated pasture as a reclamation process is sometimes successful if immediate results are not required, but the first few crops may be failures. Range is the most common use of this soil. (Capability unit IVs–8; Storie index rating 11)

Lewis loam, strongly saline-alkali, 0 to 1 percent slopes (LnA).—Much of this soil is crusted with salts or is

barren of vegetation. Reclamation is difficult because of the very slowly permeable hardpan. Planting crops is not advisable. It is used almost entirely for range. (Capability unit VIs–8; Storie index rating 4)

Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes (LoA).—This soil is generally a little darker colored than Lewis loam, slightly saline-alkali, 0 to 1 percent slopes, and is more difficult to work because it is finer textured and more slowly permeable.

This soil is not well suited to crops. Rice and irrigated pasture can be grown, as well as some dryfarmed grain. After being reclaimed by growing rice, some areas have been greatly improved. This soil produces a good stand of saltgrass, which makes good range forage. Some areas formerly used for row crops and a few areas formerly used for irrigated pasture have since reverted to range. When reclaimed, this soil is suited to rice, cotton, grain, sugar beets, and irrigated pasture. Gypsum should be added to reduce the alkalinity. Planting deep-rooted crops is not advisable. Crops not resistant to alkali should not be grown until the soil has been reclaimed and farmed for several years to alkali-tolerant crops. (Capability unit IIIs–8; Storie index rating 23)

Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes (LpA).—This soil is difficult to reclaim because of the moderate content of salts and alkali and the very slow permeability of the subsoil. A considerable part of it is subject to a high water table. Very little of it is cultivated, except small areas of rice and irrigated pasture. It produces a rank stand of saltgrass, which makes fairly good range forage almost the year around. Some areas are occasionally irrigated by flooding with water diverted from drainage ditches or overflow from the irrigation systems. Included are some dark grayish-brown to dark-gray soils that are similar to Landlow silty clay loam but contain moderate concentrations of salts and alkali. (Capability unit IVs–8; Storie index rating 10)

Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes (LrA).—This soil cannot be used for crops, and it produces only fair to poor range forage. Some areas of clay texture are included, as well as some dark grayish-brown to dark-gray soils that are similar to Landlow silty clay loam but contain strong concentrations of salts and alkali. (Capability unit VIs–8; Storie index rating 3)

Lewis clay, slightly saline-alkali, 0 to 1 percent slopes (LgA).—This soil is similar to Lewis loam, slightly saline-alkali, 0 to 1 percent slopes, but in most places the surface soil is gray to dark gray.

Most of this soil is in rice, or was formerly in rice and now is used for irrigated pasture. This soil is very difficult to work. It puddles easily and forms very hard, dense clods if worked when too moist. Reclamation is very difficult because the soil is very slowly permeable. Yields from irrigated pasture are limited after livestock have trampled and puddled the surface. (Capability unit IVs–8; Storie index rating 15)

Lewis clay, moderately saline-alkali, 0 to 1 percent slopes (LhA).—This soil is very slowly permeable and is difficult to work. Planting crops is not advisable. The best use is range or natural grassland that is occasionally flooded. (Capability unit VIs-8; Storie index rating 6)

Madera Series

The Madera soils are on gently undulating old alluvial fans and terraces, mainly in the southeastern part of the Area. They are well drained, but internal drainage is restricted by a cemented hardpan. The depth to ground water is many feet in most places. The mound, or hogwallow, microrelief is characteristic of the Madera soils, but much of it has been leveled.

The parent material of Madera loam was derived from areas of metamorphosed sedimentary rock, and the sandy alluvium from which the other Madera soils developed was derived mostly from granodiorite. The vegetation appears to have been mainly alfileria and grasses and a few oak trees.

These soils are strongly weathered, and in the lower part of the subsoil they have an indurated hardpan cemented with silica and iron. On the old Chowchilla River alluvial fan, the Madera soils are associated with the San Joaquin and Alamo soils. Toward the west, the Madera soils grade into the saline-alkali Fresno soils, which are imperfectly drained.

The Madera soils are very similar to the San Joaquin soils, except in color and reaction. The Madera soils have a light yellowish-brown surface soil and a brown or dark-brown subsoil above the hardpan. The hardpan is not so reddish brown as the San Joaquin hardpan. The subsoil is slightly acid to neutral, and in a few places above the hardpan it is intermittently calcareous. Lime is common within the hardpan and below it. Lime is rare in the San Joaquin hardpan and occurs only in thin seams.

Madera sandy loam, 0 to 3 percent slopes (MdA).—This light-colored, well-drained soil lies on gently undulating old fans of the Chowchilla River, in the southeastern part of the Area. It is shallow to moderately deep over a hardpan. In wet years the soil is waterlogged for short periods in the spring.

Representative profile:

1. The surface soil, to a depth of 8 to 18 inches, is light yellowish-brown sandy loam that is friable and granular when moist but very hard and essentially massive when dry. This layer is low in organic matter. The reaction is neutral or very slightly acid.
2. The subsoil consists of 5 to 10 inches of brown, firm sandy clay loam that has weak, blocky structure. It rests directly upon a ½- to 2-inch layer of dark-brown, neutral or mildly alkaline, blocky sandy clay.
3. The hardpan is brown to reddish brown. It is rocklike, with a tendency toward thick, platy structure. It generally contains lime in seams, and it is stained with purplish-black manganese dioxide in many places. The hardpan is 4 to 12 inches thick and becomes softer in the lower part.
4. Below the hardpan are light-brown to reddish-yellow, massive, sandy, granitic sediments that are stratified, calcareous, and semiconsolidated in places.

The lime is intermittent in the hardpan and rarely appears in the sandy clay above. Included are many small spots of Alamo clay and areas in which the hardpan is nodular. Small areas of the more reddish colored San Joaquin soils are also included. The mound microrelief, naturally common on this soil, has generally been destroyed by cultivation, although traces of it can be detected.

The surface soil is moderately permeable, but the hardpan is practically impermeable to water or roots. The

available water holding capacity is moderate. Runoff is slow, and the erosion hazard is slight. Fertility is low. This soil is easily worked, but forms a plowsole if cultivated when too moist.

Where this soil is not irrigated, its use is limited to growing dryfarmed grain. The common dryfarming practice is to plant barley every other year, alternating with cultivated fallow, which conserves a little moisture and builds up the nitrogen level. The grain is seeded in the fall after the first rains and harvested in June or July. The stubble is often grazed and then plowed under in the fall. The soil is disked twice in the fallow summer season. Many fields are a square mile or more in size.

Clover pasture, grain, milo, cotton, grapes, and alfalfa are grown under irrigation. Considerable fertilizer is used in some places. One area is used for nursery stock for fruit trees and ornamentals. Careful management of irrigation water is required to avoid building up a perched water table above the hardpan. The high water table is detrimental to most of the crops except clover. Deep-rooted crops are not ordinarily profitable. (Capability unit IVs–3; Storie index rating 28)

Madera sandy loam, 3 to 8 percent slopes (MdB).—This soil is used entirely for dryfarmed grain and range. It cannot be leveled successfully because of the shallow hardpan. Pasture can be irrigated if the soil is smoothed carefully and water is applied slowly. The hazard of erosion is slight. (Capability unit IVe–3; Storie index rating 27)

Madera fine sandy loam, 0 to 3 percent slopes (MaA).—This soil has a brown, pale-brown, or light-brown surface soil. It is used in the same way as Madera sandy loam, 0 to 3 percent slopes. Yields of dryfarmed grain are slightly higher because the supply of available moisture is greater. (Capability unit IVs–3; Storie index rating 30)

Madera loam, 0 to 1 percent slopes (MbA).—This inextensive soil occurs only along Deadman and Dutchman Creeks, east of the Southern Pacific tracks. The parent material was derived entirely from metamorphosed sedimentary rocks rather than from predominantly granitic rocks. The surface soil is smoother than that of Madera sandy loam, 0 to 3 percent slopes, and is free of harsh, angular grit. The texture varies from loam to silt loam. The claypan subsoil is grayish brown rather than dark brown.

This soil is used for cotton, irrigated pasture, dryfarmed grain, figs, and range. Yields are higher than on the coarser textured Madera soils. Even deep-rooted crops do fairly well if overirrigation is avoided. Response to nitrogen and phosphorus fertilizers is good. Only about a third of this soil is irrigated; most of the remainder is in range and dryfarmed grain. (Capability unit IVs–3; Storie index rating 31)

Madera loam, slightly saline-alkali, 0 to 1 percent slopes (McA).—This soil occurs in a few small areas east of Le Grand, mostly in grainfields. It shows as slick spots, salt crusts, and spots where the grain grows poorly. The soil differs little from Madera loam, 0 to 1 percent slopes, except for the salts and occasional periods of high water table in the spring. After drainage has been established, the application of sulfur or gypsum and a few heavy irrigations would probably help reclaim this soil. (Capability unit IVs–3; Storie index rating 25)

Marguerite Series

The Marguerite soils are associated with the Yolo soils on the alluvial fans and flood plains of Miles, Owens, Deadman, and Dutchman Creeks. These small streams drain foothill areas underlain chiefly by slate and metasandstone of the Mariposa formation. The fans and flood plains are nearly level or very gently sloping. Drainage is good. Where drainage is poor, the Burchell soils have developed. The Wyman soils are similar to the Marguerite soils, but are brown and developed from basic alluvial parent material.

The Marguerite soils have a deep rooting zone. They are gray to grayish brown in color. The structure when moist is granular. The texture is loam or silt loam. The subsoil contains slightly more clay than the surface soil. The reaction is neutral to mildly alkaline. These soils are fertile, easy to work and irrigate, and very productive. The vegetation is mainly grass, and probably it originally included scattered oaks.

Marguerite loam, 0 to 1 percent slopes (MeA).—This deep, dark-colored, well-drained soil is intricately associated with the Yolo soils. It occurs mainly along Miles, Owens, Deadman, and Dutchman Creeks, in the southeastern part of the Area. Fresh alluvium is deposited only occasionally by spring floods.

Representative profile:

1. The surface soil, to a depth of 10 to 20 inches, is gray, friable, granular loam that is slightly acid to neutral. It is hard and essentially massive by the end of the long dry summer. It is moderately low in organic matter. Roots are abundant. The transition to the subsoil is gradual to distinct.
2. The subsoil is neutral to mildly alkaline, grayish-brown clay loam that has weak, subangular blocky structure and is stained with colloids in a few places. It is hard to very hard when dry but friable when moist. It contains many roots and insect holes. Slight amounts of disseminated lime occur in the lower part. This layer is about 1 foot thick. The transition to the next layer is gradual.
3. This layer is massive, brown, friable, slightly stratified loam.

Small areas of Yolo soils are included.

This soil is moderately permeable and easy to work. Surface runoff is slow. There is little or no erosion hazard. The water-holding capacity and fertility are high.

This soil is well suited to intensive agriculture. Near Planada, it is being used for truck crops, figs, irrigated pasture, cotton, milo, and peaches, all under irrigation. Yields are comparable to those on the highly productive Wyman soils. Small amounts of nitrogen and phosphorus fertilizers are added. Good yields of dryfarmed barley are produced in a few areas. The few acres used for range produce an abundance of forage. (Capability unit I–1; Storie index rating 95)

Marguerite silty clay loam, 0 to 1 percent slopes (MfA).—This soil is associated with Marguerite loam, 0 to 1 percent slopes, and with the Yolo and Wyman soils. It is finer textured than Marguerite loam, 0 to 1 percent slopes, and it is more likely to puddle and to form a plowsole. In places where this soil grades into the Burchell soils, the drainage is imperfect.

This soil is used in much the same way as Marguerite loam, 0 to 1 percent slopes. More careful cultivation is needed, however, as this soil tends to puddle and form

fairly large clods if cultivated when too moist. Yields are comparable to those on Honcut and Wyman soils. (Capability unit I-1; Storie index rating 85)

Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes (MgA).—This soil formed where 3 to 5 feet of alluvium had been deposited over old hardpan soils. A 6-inch layer just above the hardpan is faintly mottled. Little or no trace of the upper layers of the buried soil remains, and the transition to the hardpan is generally very abrupt. At times a perched water table lies above the hardpan.

This soil is used in much the same way as Marguerite silty clay loam, 0 to 1 percent slopes. Orchards must be irrigated with considerable care, to avoid forming a perched water table. (Capability unit IIs-3; Storie index rating 76)

Merced Series

The Merced soils occur on the broad flood plain of the San Joaquin River, in nearly level areas cut by a few trenchlike drainageways. These soils are poorly drained and are affected by a high water table. In the past they were frequently flooded early in summer and the floodwater often remained for a considerable period. The construction of Friant Dam, farther up the San Joaquin River, has markedly cut down the frequency of the floods.

The alluvium from which the Merced soils formed was derived from mixed igneous rocks, predominantly granitic. It has weathered rapidly to form a soil that has a very dark gray surface soil and a clay subsoil with a moderate accumulation of lime. The vegetation is a dense stand of grasses and herbs, and in many areas a carpet of lippia.

Associated with the Merced soils are soils of the Columbia, Temple, Piper, Waukena, and Rossi series. The Merced soils are finer textured, darker colored, and more poorly drained than the Columbia soils. They are finer textured and contain less organic matter than the Temple soils. The Piper, Waukena, and Rossi soils are slightly above the ordinary flood level and have accumulated strong concentrations of salts and alkali.

Merced clay loam, slightly saline, 0 to 1 percent slopes (MmA).—This dark-colored soil lies on the flood plain of the San Joaquin River. Annual summer floods formerly kept the soil damp, and it supported a lush growth of grass and lippia. Slight concentrations of neutral salts are common, but they rarely appear as a white crust, because of the moderately high content of organic matter.

Representative profile:

1. The surface soil, to a depth of 5 to 12 inches, is very dark-gray, neutral or mildly alkaline clay loam that has strong, blocky structure. It is moderately high in organic matter and may contain a little neutral salt.
2. The subsoil is dark-gray clay that has moderate, blocky structure. It is very hard when dry and very sticky when wet. It contains light-colored, segregated lime. The lower part of the subsoil is mottled sandy clay that is olive brown when moist and light yellowish brown when dry. It contains a moderate quantity of lime and some neutral salts. Roots are mainly in seams. The subsoil extends to a depth of 4 or 5 feet gradually decreasing in content of lime and clay with increasing depth.
3. The clay merges into clay loam. At a depth of about 5 or 6 feet this grades to somewhat stratified, slightly calcareous sandy loam that is mottled light yellowish brown.

Small areas of Temple, Columbia, Piper, and Rossi soils are included.

The surface soil is moderately permeable, and the subsoil is slowly permeable. Surface runoff is ponded to very slow. This soil is occasionally flooded. The depth to the water table fluctuates between 2 and 6 feet. There is a slight hazard of channel cutting during floods. Occasionally silt loam alluvium is deposited. This soil is moderately difficult to work, but fertility is high.

Most of this soil is not cultivated, because of the poor drainage and the slight accumulation of salts. Several areas, however, have been leveled and planted to cotton and sugar beets with moderate success. Except in a few channels, irrigation is not difficult. Since Friant Dam has controlled the floods and lowered the water table, it is possible that much of this soil can be reclaimed from salts and brought under irrigation. Sugar beets, cotton, alfalfa, and irrigated pasture are the best crops. (Capability unit IIIw-2; Storie index rating 54)

Merced clay loam, moderately saline, 0 to 1 percent slopes (MnA).—Spotty yields of cotton and sugar beets indicate the need for reclaiming this soil. Heavy irrigation, improved drainage, and possibly the application of sulfur or gypsum are required to leach away the salts. Crops, other than rice or irrigated pasture, should not be planted until some of the salts have been removed. Leaching will be slow because of the clay subsoil, but the presence of neutral salts indicates that water penetration can be maintained without heavy applications of gypsum. (Capability unit IIIw-6; Storie index rating 30)

Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes (MpA).—This soil is similar to Merced clay loam, slightly saline, 0 to 1 percent slopes, except that a deposit of silt and very fine sand has been recently laid down on the surface by flood waters. These deposits, 6 to 12 inches thick, provide a better seedbed, improve workability, and should result in slightly higher yields. (Capability unit IIw-2; Storie index rating 57)

Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes (MoA).—This soil lies along the San Joaquin River, north of the bridge on the road to Gustine. It is cut by channelways to such an extent that cultivation is impractical; it is used only for woodland pasture. (Capability unit VIw-6; Storie index rating 6)

Merced clay, slightly saline, 0 to 1 percent slopes (MhA).—This soil is similar to Merced clay loam, slightly saline, 0 to 1 percent slopes, except that the surface layer is darker gray and finer textured and it cracks into large blocks. It is crumbly in the natural state. When the soil is irrigated and cultivated, it runs together and becomes very sticky when wet and very hard when dry. This soil is not extensive and occurs only in the Turner Ranch area.

Clay texture, poor drainage, and salinity limit the use of this soil to a few salt-tolerant crops. Yields of cotton and sugar beets are moderately high. Alfalfa and grain can be grown. When it was flooded annually, this soil produced good grass pasture. Now that the floods are partly controlled, the vegetation is changing to winter and spring grasses and plants; the lippia and water-loving grasses are dying out. The Central Valley Project

will result in a steady flow in the San Joaquin River, and it should then be possible to irrigate this soil and use it for pasture and crops. (Capability unit IIIw–5; Storie index rating 38)

Merced clay, moderately saline, 0 to 1 percent slopes (MkA).—This soil is limited by its fine texture and poor drainage. Crops will not do well until the amount of salts is reduced by reclamation. Reclamation would be slow and expensive. Most of this soil is used only for range. (Capability unit IIIw–5; Storie index rating 21)

Montpellier Series

Most of the Montpellier soils occur on high terraces between the Merced and Tuolumne Rivers. The area is made up of old deposits of granitic alluvium. These deposits have been dissected, and the relief is now rolling and hilly. In some places the alluvium has washed away, and the underlying beds of andesitic tuff are exposed. Where a considerable thickness of the granitic alluvium remains, this material has weathered to the Montpellier soils. The upper part of the alluvial deposits consists of coarse sand and fine gravel in some areas and of medium and coarse sand in others.

The Montpellier soils are well drained. They have a pronounced gritty clay or sandy clay loam subsoil, which is in sharp contrast to their coarse sandy loam surface soil. The vegetation consists of alfileria and annual grasses.

Other well-drained soils that developed from the same kind of granitic alluvium, but were less strongly weathered, are the Snelling, Greenfield, and Hanford soils. Associated with the Montpellier soils are the Rocklin and Whitney soils.

Montpellier coarse sandy loam, 0 to 3 percent slopes (MrA).—This soil occurs in the northern part of Merced County, south of Yosemite Lake. Most of it is on small, gently undulating benches or ridgetops within steeper, undulating and rolling areas.

Representative profile:

1. The surface soil, to a depth of 18 to 23 inches, is brown, medium acid, coarse sandy loam. It is friable and has weak, granular structure when moist but becomes hard and essentially massive when dry. Below a depth of 8 inches the soil is slightly lighter in color and has a faintly pinkish tinge. At a depth of between 20 and 23 inches it is very faintly mottled with gray. Roots and insect burrows are common. The lower boundary is abrupt.
2. This layer, to a depth of 31 inches, is reddish-brown, slightly acid sandy clay loam. It is very hard when dry, firm when moist, and plastic and sticky when wet. The structure is weak blocky, with a tendency to be weak prismatic. Few roots penetrate this layer, which is 8 to 12 inches thick. The lower boundary is gradual.
3. To a depth of 55 inches, this layer is reddish-brown sandy clay loam, massive but otherwise similar to the layer above. The transition to the next layer is diffuse.
4. This layer is brown, massive sandy clay loam, similar to the layer above. It extends to a depth of 62 inches.
5. This layer is pale-brown, firm sand and fine gravel that closely resembles decomposed granite in composition and appearance.

The surface soil is rapidly permeable, but the subsoil is slowly permeable and few roots penetrate it. Surface runoff is slow. There is a slight hazard of erosion. The soil is low in nitrogen, phosphorus, sulfur, and possibly zinc. It is easy to work. The water-holding capacity is moderate.

This soil is used chiefly for dryfarmed barley. The common practice is to summer fallow in alternate years. Southwest of Yosemite Lake, this soil is used for range. (Capability unit IVs–3; Storie index rating 51)

Montpellier coarse sandy loam, 3 to 8 percent slopes (MrB).—Most areas of this soil are on ridgetops, associated with Snelling, Whitney, and Rocklin soils. A number of areas having a sandy loam surface layer are included. Surface runoff is slow. There is a slight hazard of erosion.

Most of this soil is used for dryfarmed grain. In seasons of low rainfall, the grain is cut for hay. In normal years, the grain is harvested and the straw baled for bedding or feed. (Capability unit IVe–3; Storie index rating 48)

Montpellier coarse sandy loam, 8 to 15 percent slopes (MrC).—The surface layer of this soil is only 15 to 22 inches thick. Slopes of 10 to 15 percent are the most common. This soil is associated with the Whitney soils, which have a finer textured surface soil and are underlain at depths of about 2 feet by softly consolidated parent material. Surface runoff is medium, and the erosion hazard is moderate.

Most of this soil is used for dryfarmed grain and supplemental grazing. There is danger of sheet and rill erosion where the soil is cultivated. Remarkable increases in forage yields are obtained by reseeding with annual clovers and by adding sulfur in the form of gypsum. (Capability unit IVe–3; Storie index rating 43)

Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded (MrC2).—This soil is similar to Montpellier coarse sandy loam, 8 to 15 percent slopes, except that in some places the surface layer has been stripped off and the subsurface soil, which is brown with a pinkish cast, has been exposed.

Most of this soil is farmed to barley. Some areas have been retired to range. Erosion control by contour farming is difficult because the slopes are generally very complex. (Capability unit VIe–9; Storie index rating 34)

Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded (MrD2).—The surface layer of this soil is generally only 6 to 12 inches thick; in places it has been completely removed.

A large proportion of this soil is or has been cultivated, and rill erosion has resulted. The practice of disking and planting immediately after the first fall rain has been chiefly responsible for the erosion, which occurs in the fall and winter. During heavy rains, large quantities of surface soils are washed to the base of slopes and deposited as miniature, but distinct, alluvial fans. Occasional heavy rains before the grain is up cause severe sheet and rill erosion. The steep slopes, commonly about 20 percent, cause some difficulty in tillage and harvesting. (Capability unit VIe–9; Storie index rating 30)

Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded (MrE2).—This soil is used mainly for range pasture. Because of the steep slopes, considerable sheet and rill erosion occurs. In many spots the reddish-brown subsoil is exposed.

Miniature, but distinct, alluvial fans are deposited at the base of most of these steep slopes. In some places these fans have been gullied by subsequent rains. (Capability unit VIIe–9; Storie index rating 19)

Pachappa Series

The Pachappa soils occur chiefly on the Chowchilla River alluvial fan. Smaller areas are on the Merced River fan. The parent material is sandy granitic alluvium derived from the high Sierras and deposited in nearly level to very gently undulating ridges. Drainage is good. The vegetation consists of alfileria and annual grasses, particularly ripgut grass.

The profile generally consists of about 16 inches of slightly acid, light brownish-gray or pale-brown sandy loam or fine sandy loam resting on a brown, mildly alkaline sandy clay loam subsoil that is about 14 inches thick and contains segregated lime in the lower part. Below the subsoil is very slightly calcareous, yellowish-brown sandy loam. In a number of areas this soil overlies the older Fresno soils at a depth of 4 to 6 feet. Saline-alkali spots are common.

Pachappa sandy loam, 0 to 1 percent slopes (PdA).—This is a well-drained, light brownish-gray to pale-brown soil developed from granitic alluvium. It apparently had a high water table at one time, but dry years and pumping for irrigation have improved the drainage, especially near El Nido. The soil generally is on nearly level alluvial fans no longer subject to overflow. The vegetation consists of grasses, small leafy plants, and a few scattered oaks.

Representative profile:

1. The surface soil, to a depth of 12 to 16 inches, is light brownish-gray to pale-brown, slightly acid, very friable sandy loam. It has weak, granular structure when moist but is essentially massive when dry. It is low in organic matter. The transition to the subsoil is fairly distinct.
2. The subsoil is brown sandy clay loam. It has weak, subangular blocky structure and some darker brown coatings. It is about 12 to 18 inches thick. The upper part is neutral to mildly alkaline, and the lower part is moderately alkaline and contains some segregated lime. This soil is hard when dry but friable when moist. It grades into the alluvium below.
3. This layer is made up of yellowish brown, very friable sandy loam and sand, somewhat stratified and very slightly calcareous in the upper part.

The subsoil in places is a heavy sandy loam. Small spots of Hanford and Borden soils and very narrow streaks of Tujunga loamy sand are included.

The surface soil is rapidly permeable; the subsoil is moderately permeable. Runoff is very slow, and there is no erosion hazard. The fertility is fairly high. Nitrogen is the only known deficiency, but zinc may also be lacking. This soil is easily worked to a granular tilth. The water-holding capacity is moderate.

This soil is well suited to irrigated agriculture. It is limited by the calcareous lower subsoil and, in some places, by a fluctuating water table. A wide range of field crops and vegetables can be grown successfully. Most of the acreage is cultivated to cotton, alfalfa, irrigated pasture, and field crops. A few areas are in orchard fruits and nuts, grapes, and nursery stock. Only nitrogen fertilizer and manure are used. Fairly frequent irrigation is necessary, but furrows or checks can be used if the runs are not too long. Where a great deal of water is pumped, it is not advisable to plant orchard crops, such as peaches and almonds, that are sensitive to lime and sodium. (Capability unit I–1; Storie index rating 90)

Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes (PeA).—The slight concentrations of salts and alkali are in the subsoil and in places in the subsurface layer of this soil. Where pumping has lowered the water table, the excess salts and alkali are rapidly being removed by leaching. Heavy irrigations or the growing of crops such as irrigated pasture hasten the leaching. Alfalfa and cotton are moderately successful. (Capability unit IIs–6; Storie index rating 63)

Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes (PgA).—This soil has a hardpan cemented with lime and silica at a depth of 3½ to 5 feet. This hardpan impedes internal drainage; consequently, a perched water table is common in irrigated areas.

This soil is fairly well suited to field crops but not to orchards. Irrigation should be controlled so that only the uppermost 3 feet of soil is moistened. Overirrigation will build up a perched water table and may cause accumulation of salts and alkali in the root zone. (Capability unit IIs–3; Storie index rating 67)

Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes (PfA).—This soil is similar to Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes, but in addition it has, at a depth of 3½ to 5 feet, a hardpan like that beneath the Fresno soils. The hardpan prevents leaching of the excess salts. If a good system of ditch or tile drainage is established to drain irrigation water off laterally, the salts and alkali can be reduced enough so that many kinds of crops can be grown.

Alkali-tolerant crops, such as cotton and alfalfa, can be grown even before reclamation, but yields are better after reclamation. Small alkali spots can be improved by light applications of sulfur or gypsum.

Some fine sandy loam is mapped with this soil. (Capability unit IIs–3; Storie index rating 47)

Pachappa fine sandy loam, 0 to 1 percent slopes (PaA).—This soil has a slightly less permeable subsoil than Pachappa sandy loam, 0 to 1 percent slopes, and slightly higher moisture-holding capacity. Most of it is cultivated, except for a few areas affected by salts and alkali. Management needs are much the same as for Pachappa sandy loam, 0 to 1 percent slopes, but this soil need not be irrigated quite so frequently. (Capability unit I–1; Storie index rating 95)

Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (PbA).—This soil has slightly higher water-holding capacity than Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes. It is similarly used and managed. (Capability unit IIs–6; Storie index rating 67)

Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes (PcA).—This soil has slightly higher moisture-holding capacity than Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes. Its surface soil dries out harder than that of the sandy loam and puddles more easily if worked when too moist. Field crops, irrigated pasture, and alfalfa do well on this soil. (Capability unit IIs–3; Storie index rating 75)

Pentz Series

The Pentz series consists of shallow, grayish-brown soils developed from andesitic tuff. The tuff was buried by the gravelly materials of the Redding soil and then exposed again by geologic erosion, which also cut the material into undulating or rolling relief. The parent rock is stratified into layers that vary in hardness and resistance to erosion. This formation weathers into conical hills ringed with outcrops of the harder strata. The beds range from fine tuffaceous sandstone to conglomerate made up of andesitic gravel and tuff. They have a characteristic bluish-gray or gray color due to an oxidation layer that forms on the outer surface of each grain.

The Pentz soils generally have a slope of more than 10 percent, but in some areas where the mantle of loose material has been recently stripped away by erosion, the slopes are more gentle. Drainage is good to somewhat excessive. The vegetation is annual grass and herbs.

The Pentz soils are associated with Peters and Raynor clay soils. The Pentz soils are the least weathered of the 3 series, and Raynor soils are the most weathered. The Peters soils are shallow, neutral to slightly acid clay. The Raynor soils are moderately deep to deep and have segregated lime in the subsoil. The Amador soils were developed from rhyolitic tuff; they are much more acid and less fertile than the Pentz soils.

The profile of the Pentz series generally consists of about 12 inches of slightly acid, grayish-brown loam. It has a weak, granular structure when moist and is essentially massive when dry. It contains various amounts of gravel washed in from other soil materials. This rests directly upon partly weathered, bluish-gray to nearly white, andesitic tuff. In places the tuff has a hard surface about ½ inch thick. Well-formed mounds cause variations in thickness of the surface soil from 2 to 3 inches up to 24 inches. Trenches cut through these mounds reveal that the surface of the rock is generally about constant in elevation, and the mounds are domed above it. The mounds are most evident on gentle slopes. They do not appear on the rolling slopes.

Pentz loam, 0 to 8 percent slopes (PmB).—This soil lies on low foothills and dissected terraces, mainly north of Snelling. It occupies undulating areas that have some mound microrelief and a few outcrops of horizontal rock ledges. The vegetation is a fair growth of grass, burclover, and alfileria.

Representative profile:

1. The surface soil, to a depth of 8 to 20 inches, is grayish-brown, slightly acid, hard loam. It is friable when moist. It contains a little scattered rounded gravel. The boundary between it and the parent rock is abrupt.
2. This layer is stratified, poorly sorted, partly weathered material made up of clay and rounded fragments of tuff that range in size from fine sand to fragments that are about ½ inch in diameter and have a bluish coating. The rock ranges in hardness from slightly compact to moderately hard; the ledges are generally the hardest. The uppermost ¼ to ½ inch of this material is cemented in some places.

A few small areas of sandy loam and clay loam are included.

This soil is moderately permeable. Drainage is good. Runoff is medium, but there is only a slight erosion hazard. Fertility is moderate, but the soil is difficult to work.

Because it is shallow and has a low moisture-holding capacity, most of this soil is used only for range. The grass is of good nutritive value. Dryfarmed grain has been grown in places, but cultivation is not advisable. (Capability unit VIIe-3; Storie index rating 22)

Pentz loam, 8 to 30 percent slopes (PmD).—This soil is suited only to range. Grazing does not have to be strictly controlled to avoid erosion and overgrazing. Runoff is rapid, but erosion is not apparent except on the steepest and most heavily grazed areas. The water-holding capacity is very low. (Capability unit VIIe-3; Storie index rating 19)

Pentz loam, 30 to 75 percent slopes (PmE).—This inextensive soil occurs chiefly along entrenched streams and on a few distinct conical hills. It is generally less than 12 inches deep. Outcrops of andesitic tuff appear along drainageways and on the steeper slopes. The water-holding capacity is very low.

This soil is unsuitable for cultivation and provides only scant forage. Restriction of grazing may be advisable in some places to control erosion. (Capability unit VIIe-3; Storie index rating 8)

Pentz gravelly loam, 0 to 8 percent slopes (PkB).—The gravel in this soil interferes with cultivation, but it does not restrict the use of the soil for range. Erosion is not apparent. Grazing control is needed only to maintain the quality of the forage. The root zone is shallow, and the water-holding capacity is low. Cultivation is not advisable. (Capability unit VIIe-3; Storie index rating 15)

Pentz gravelly loam, 8 to 30 percent slopes (PkD).—All of this soil is used for range. Runoff is rapid. A few heavily grazed areas show some signs of erosion. Some grazing control is needed to maintain the soil and the quality of the range. (Capability unit VIIe-3; Storie index rating 14)

Pentz clay loam, 0 to 8 percent slopes (PhB).—This soil appears to be transitional between Pentz loam and Peters clay. It has slightly higher moisture-holding capacity than Pentz loam, 0 to 8 percent slopes, and supports a better growth of burclover and grass. Also, it is more plastic when wet and a little harder and cracks more.

This soil is used mainly for range. A few spots are within grainfields, but yields are only fair. Larger areas are not cultivated because of the shallow or very shallow profile. (Capability unit VIIe-3; Storie index rating 21)

Pentz clay loam, 8 to 30 percent slopes (PhD).—Because of its steep slopes, this soil has rapid runoff and a severe erosion hazard. Range pasture is its only use. Outcrops of andesitic tuff are common in the steepest areas and along drainageways. (Capability unit VIIe-3; Storie index rating 17)

Peters Series

The Peters soils formed from material weathered from andesitic tuff. They ordinarily occur on slightly concave slopes or in saddles or protected areas where erosion is slow and the soils remain moist a little later in the summer than the soils in surrounding areas. The topography is gently sloping to hilly. Although the parent material weathers to clay very rapidly, these soils are shallow, probably because they have been weathering a relatively short time. The vegetation is annual grasses and herbs.

The Pentz and Raynor soils formed from the same kind of parent material as the Peters soils, but the Pentz soils are lighter colored and medium textured, and the Raynor soils are moderately deep and are calcareous in the subsoil.

The profile of the Peters soils consists essentially of dark-gray, slightly acid, blocky clay that grades abruptly into andesitic tuff at a depth of from 12 to 24 inches. In many places there are cobblestones or gravel—remnants of a mantle of Redding gravel that was stripped away by erosion before the Peters soils were formed.

Peters clay, 0 to 8 percent slopes (PnB).—This dark-colored soil occurs in the same general area as the Pentz and Raynor soils, on the low foothills and dissected terraces in the eastern and northeastern parts of the Area. It is on broad slopes or in saddles between higher hills.

Representative profile:

1. The soil, to a depth of 12 to 24 inches, is dark-gray, slightly acid clay that cracks when dry to form large blocks. Gravel or cobblestones are scattered in many places on the immediate surface. The boundary between the soil and the parent material is abrupt.
2. This layer is hard but slightly weathered bluish-gray andesitic tuff.

A few spots of the deeper Raynor soils and the shallower Pentz soils are included. The color grades toward brown in places.

This soil is well drained and slowly permeable. It has a low water-holding capacity. Runoff is medium, but the erosion hazard is slight. Fertility is moderate.

Nearly all of this soil is used for range. A few areas are included in grainfields that are composed mainly of Whitney soils.

This is a difficult soil to cultivate. Because it is generally associated with cobbly soils that are unsuited to cultivation, its best use is range. It produces large amounts of good-quality forage but only fair yields of dryfarmed grain. The most favorable slopes are suitable for irrigated pasture, but leveling must be kept to a minimum because of the shallowness of the profile. (Capability unit IVe–5; Storie index rating 19)

Peters clay, 8 to 15 percent slopes (PnC).—This soil occurs on the dissected slopes of old terraces where the underlying andesitic tuff is exposed. Runoff is rapid, and the erosion hazard is moderate. This soil is not well suited to irrigation because it is fine textured and sloping. It is best suited to range. (Capability unit IVe–5; Storie index rating 18)

Peters cobbly clay, 0 to 8 percent slopes (PoB).—This soil has many cobblestones and considerable gravel in the surface soil. The cobblestones are a serious obstacle to cultivation. This soil is best used for range. Range management is the same as for Peters clay, 0 to 8 percent slopes. (Capability unit VIe–5; Storie index rating 16)

Peters cobbly clay, 8 to 30 percent slopes (PoD).—This soil is shallow, it has low moisture-holding capacity, and it contains gravel and cobblestones. Runoff is rapid, and the erosion hazard is moderate. Included are a very few areas that are even steeper than 30 percent.

This soil is best used for range. (Capability unit VIe–5; Storie index rating 14)

Piper Series

The Piper soils occur on low mounds and ridges on the San Joaquin River flood plain. They are just above the level of the frequent early-summer floods. Excess salts and alkali have accumulated as a result of capillary rise from the fluctuating water table. Natural drainage is imperfect. The parent material is sandy mixed alluvium, mostly granitic. The plant cover is mainly saltgrass and other salt-tolerant plants.

The Columbia and Temple soils developed from the same kind of material as the Piper soils, but they are of more recent origin and are flooded much more frequently. The Temple soils are darker colored and finer textured, whereas the Columbia soils lack the lime and excess salts and alkali.

The main features of the Piper soils are a grayish-brown fine sandy loam surface soil, a light-gray subsoil that contains a large amount of segregated and nodular lime, and a mottled light-gray or light yellowish-gray substratum that contains some lime.

Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes (PpA).—This grayish-brown soil occurs on mounds and ridges along the San Joaquin River flood plain. It is not extensive.

Representative profile:

1. The surface soil, to a depth of about 6 inches, is grayish-brown, very friable, strongly alkaline, calcareous fine sandy loam that contains a moderate amount of organic matter.
2. This layer is light brownish-gray, strongly calcareous, very friable fine sandy loam about 12 inches thick. It is lower in organic matter than the surface soil.
3. The light-gray fine sandy loam in this layer is high in lime and contains many hard nodules. It extends to a depth of about 4 feet. The material below is mottled and contains much less lime.

This soil is moderately permeable throughout. It has moderate water-holding capacity. Runoff is slow, and the erosion hazard is slight. This soil is easily worked to a granular tilth. Mineral fertility is high. Crop growth, however, is limited by the strong alkalinity and the lime.

These mounds and ridges are not suitable for irrigation without extensive leveling. The common practice is to cut the mounds to the same level as the surrounding areas and use the excess material to fill channels and depressions. This soil then remains as a sandy, light-gray or light yellowish-gray spot in otherwise dark-colored areas of Temple and Merced soils.

Alfalfa, cotton, or sugar beets, which are relatively salt tolerant, can be grown with some success. Other crops should be tried on a limited experimental basis before they are planted extensively. (Capability unit IIw–2; Storie index rating 77)

Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes (PsA).—Crops cannot be grown on this soil until it is reclaimed. Gypsum is needed, along with deep leaching when the water table is low. These areas must be leveled before reclamation. As the soil is moderately permeable, leaching should effectively reduce the salt concentrations as long as the water table remains low. When rainfall is above normal, the water table may rise and return the salts to the soil. Even after reclamation, this soil is less fertile than the surrounding soils of the Temple series. (Capability unit IIIw–6; Storie index rating 43)

Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes (PtA).—This soil is gray to light gray in

color. It is covered with puffy salt crusts. There is little or no vegetation, and the soil is unfit for cultivation unless reclaimed. Reclamation by leaching and applying amendments is possible but moderately difficult. (Capability unit IVw–6; Storie index rating 13)

Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes (PuA).—This unit occurs only in a small area on the San Joaquin River flood plain, north of the bridge on the road to Gustine. The area is cut by stream channels. It would require extensive leveling before it could be cultivated. However, the high concentration of salts and alkali makes leveling and cultivation impractical. The best use for these soils is range. Capability unit VIw–6; Storie index rating 8)

Pits

Pits (Pv).—The main areas of this miscellaneous land type are along the railroads. Gravel or sand has been removed and used for roadbed fill or for concrete in construction work. This land type has no agricultural value. (Capability unit VIIIs–1; Storie index rating less than 5)

Porterville Series

The Porterville soils occur on gently sloping and very gently sloping areas near Planada and Le Grand. They are well drained. The parent material consisted of alluvium derived from basic igneous rocks; it is a mixture of poorly sorted clay and sand. The vegetation is grasses and herbs, including considerable burclover.

The position of the Porterville soils indicates they are comparatively old. Associated with them are the Seville clays, which are similar but have a lime-cemented hardpan in the subsoil. In some areas the Porterville soils appear to grade into soils of the Hopeton and Raynor series.

The profile generally consists of about 22 inches of reddish-brown, mildly alkaline, coarse blocky clay that forms large cracks when it dries. The secondary cracking of the surface layer forms an extremely hard, fine, blocky structure that is very stable, although it appears loose. There are a few nodules of lime in the surface layers. The stability of the surface structure permits rapid initial water penetration for a soil so high in clay, but water does not penetrate deeply because of the high moisture-holding capacity of the soil and the limited rainfall. The subsoil is reddish-brown clay and contains blotches and nodules of lime. Below the subsoil is material that ranges from clay to a fine sandy loam in texture and from dark brown to olive gray in color. Lime occurs, both in seams and disseminated, throughout the material. In some places the deeper layers are soft sandstone.

Porterville clay, 0 to 3 percent slopes (PwA).—This reddish-brown soil occurs near Planada on very gently sloping old valley fill derived chiefly from basic igneous rocks.

Representative profile:

1. The surface soil, to a depth of 18 to 24 inches, is reddish-brown clay. It is sticky and very plastic when wet. It dries in large blocks that are separated by cracks as much as 3 inches wide. The immediate surface breaks up into extremely hard, fine granules or very fine blocks that form a loose, granular tilth. This soil is mildly alkaline. A few concretions of lime are on the surface, and the number increases slightly with increasing depth. The lower part of this layer is dense and has fewer cracks. This layer grades into the subsoil below.
2. The subsoil, to a depth of 3½ to 4 feet, is reddish-brown clay mottled with white blotches of lime. In places the lime is in hard nodules. This material has weak, medium, blocky structure. It is sticky and very plastic when wet. Few roots penetrate this layer.
3. The parent material is dark-brown to olive-gray, massive clay or sandy clay that contains a few streaks of sandy material. Considerable lime is present, but it is less segregated than in the layer above, and it tends to decrease in quantity with increasing depth.

This soil resembles Seville clay, which has a lime-cemented hardpan and generally has a calcareous surface layer. A few small areas of Seville soils occur within areas of Porterville clay, 0 to 3 percent slopes, and a few spots are dark grayish brown rather than reddish brown.

This soil is limited by the clay texture and the calcareous subsoil. When dry it absorbs water quickly, but when moist it is slowly permeable. It holds large quantities of water, so that rainwater rarely penetrates deeply. Runoff is slow, and there is little or no erosion hazard. This soil is difficult to work, but not so difficult as other less granulated clays. Fertility is moderate.

About 75 percent of this soil is cultivated, and the rest is used for range. About half of the cultivated area is irrigated and used for figs, milo, and pasture. Peaches and other orchard crops do not do well, because of the calcareous subsoil. Dryfarmed grain is grown on the unirrigated areas. Nitrogen fertilizer benefits figs. Row crops respond to applications of phosphate, concentrated in spots or furrows. Broadcast spreading of commercial fertilizer produces little benefit. Irrigation water is usually applied by means of long furrows—the best method for this fine-textured soil. (Capability unit IIIs–5; Storie index rating 46)

Porterville clay, 3 to 8 percent slopes (PwB).—Most of this soil is in dryfarmed grain. Small areas are in figs and irrigated pasture. Irrigation should follow the contour. Leveling cuts should not be deep enough to expose the calcareous subsoil, which is relatively poor for growing crops. (Capability unit IIIs–5; Storie index rating 43)

Pozo Series

The Pozo soils occur on the eastern fringe of the San Joaquin River flood plain. They formed from alluvium derived mainly from granitic rocks. While they were forming, drainage was poor, the water table was high, and the areas were flooded occasionally. The relief is nearly level, but there are a few channels, which keep the water table down except during floods. The vegetation consists of annual grasses, lippia, and alkali heath.

In some characteristics the Pozo soils resemble the Merced soils, and in others, the Fresno soils. The surface soil is dark gray, like that of the Merced soils, but the subsoil is nearly white and has a thin, lime-silica hardpan, similar to that in the Fresno subsoil. Neutral salts are present in places, but little or no excess alkali is present.

Pozo clay loam, 0 to 1 percent slopes (PxA).—This soil occurs along the eastern side of the San Joaquin River

flood plain, north of the Santa Rita Bridge. It is covered only during major floods, which are now partly controlled by the Friant Dam on the San Joaquin River.

Representative profile:

1. The surface soil, to a depth of 4 to 6 inches, is dark-gray clay loam, about neutral in reaction. It has weak, medium, blocky structure when moist. It is very hard when dry but friable when moist. It is moderately high in organic matter.
2. The subsurface layer, to a depth of about 10 inches, is dark-gray, moderately alkaline, heavy clay loam or light clay that has medium, blocky structure. The lower boundary is abrupt.
3. This layer is white, moderately calcareous, massive clay loam that is hard when dry.
4. A thin, white, platy hardpan, cemented with lime and silica and resembling the hardpan of the Fresno soils, abruptly underlies the clay loam at a depth of about 2 feet. It is about 5 inches thick and is strongly cemented.
5. Below the hardpan are mottled, light yellowish-brown, massive, stratified sandy loam and fine sand that contains considerable segregated lime.

Toward the west, the dark-colored surface soil becomes thicker, and the soil grades into Merced clay loam. Toward the east, the surface soil becomes thinner, and the soil grades into the more saline-alkali Fresno loam or Fresno clay loam. In places there is a thin overwash of pale-brown fine sandy loam.

This imperfectly drained soil has very slow runoff. Permeability is moderate in the surface soil and very slow in the subsoil. The water-holding capacity is moderate. Fertility is high. The soil is moderately difficult to work. There is no erosion hazard.

This soil is used mainly for range. Cotton and alfalfa could be grown, but yields would probably be lower than on the deeper Merced clay loam, slightly saline, 0 to 1 percent slopes. (Capability unit IIIs–8; Storie index rating 34)

Pozo clay loam, slightly saline, 0 to 1 percent slopes (PyA).—The salts in this soil are not a severe problem so long as salt-tolerant and shallow-rooted crops are grown. It is difficult to leach out the salts because of the impermeable hardpan. This soil is used mainly for range. (Capability unit IIIs–8; Storie index rating 30)

Pozo clay loam, moderately saline, 0 to 1 percent slopes (PzA).—The salts can be removed from this soil by leaching. A few alkali spots occur in places. This soil is now used mostly for range. (Capability unit IVs–8; Storie index rating 17)

Raynor Series

The Raynor soils occupy gentle slopes in dissected parts of the high terraces and along the fringe of foothills. They are well drained. The parent material was andesitic tuff like that from which the Pentz and Peters soils developed. The vegetation consists mainly of wild oats and burclover.

These soils have a distinct zone of lime accumulation at a depth of 2 to 4 feet. They are associated with the Pentz and Peters soils, but they are deeper and more strongly weathered than either.

The main features of these soils are their dark gray or very dark gray color, the clay texture, the strongly developed blocky structure with large cracks, the accumulation of lime in the clay subsoil, and the dark grayish-brown, moderately fine textured, slightly calcareous lower subsoil, which grades into the light-gray or blue-gray andesitic tuff at a depth of 3½ to 6 feet. Cobblestones are commonly scattered about on the surface but are rare in the profile. These appear to have come from overlying gravel beds that have been stripped away by geologic erosion.

Raynor clay, 0 to 3 percent slopes (RaA).—Most of this soil occurs on very gentle slopes on the low foothills and dissected high terraces in the eastern and northeastern parts of Merced County. It is a dark-colored, fine-textured soil derived from softly consolidated tuffaceous rocks.

Representative profile:

1. The surface soil, to a depth of about 8 to 14 inches, is dark gray to very dark gray clay that cracks to strong, coarse blocks when it dries. Generally there is some cracking to finer blocks at the surface. The clay is very sticky and plastic when wet and very hard when dry. It is neutral to slightly acid in reaction. There are a few scattered concretions of lime in this layer, and a few cobblestones on the surface in many places.
2. The upper subsoil, to a depth of about 24 inches, is dark-gray, very hard, blocky clay that is sticky when wet. The reaction is neutral to mildly alkaline. Lime is mainly in the form of hard specks. The lower subsoil, to a depth of 2½ to 4 feet, is dark-gray or dark grayish-brown, weak, blocky clay that contains some segregated lime. The lower boundary is abrupt.
3. The parent material is a light-gray, gritty, tuffaceous, softly consolidated material that contains lime in the upper part.

In some level or slightly depressed areas, the subsoil is lighter gray and only slightly calcareous. Spots of shallower Peters soil and brown Hopeton clay are included within areas of this soil.

This soil is well drained but slowly permeable. Runoff is slow, and there is little or no erosion hazard. The soil is difficult to work. Fertility is low, but the range forage is of excellent quality.

Most of this soil is used for range. It produces considerable burclover and wild oats. A few areas are cultivated to figs and irrigated pasture.

This soil is less permeable than the Porterville soils, and irrigation must be slower. It tends to puddle when worked too wet or trampled by stock, but no more so than most clay soils. In many places the cobblestones interfere somewhat with cultivation. (Capability unit IIIs–5; Storie index rating 38)

Raynor clay, 3 to 8 percent slopes (RaB).—Except that more care is required in irrigation, management problems are the same for this soil as for Raynor clay, 0 to 3 percent slopes. Small areas are used for figs and irrigated pasture. Most of the soil is used for range. (Capability unit IIIs–5; Storie index rating 36)

Raynor clay, 8 to 15 percent slopes (RaC).—This soil is used for range, but irrigated pasture can be grown. Runoff is rapid, but there is little evidence of erosion. (Capability unit IVe–5; Storie index rating 34)

Raynor cobbly clay, 0 to 3 percent slopes (RbA).—This soil is like Raynor clay, 0 to 3 percent slopes, except that there are considerable amounts of cobblestones and pebbles on the surface and tightly embedded in the surface layer. These are remnants of the gravelly and cobbly materials that formerly covered the area and have been stripped away by erosion. Range is the best use. (Capability unit VIe–5; Storie index rating 32)

Raynor cobbly clay, 3 to 8 percent slopes (RbB).—Except for its stronger slopes and the numerous cobblestones on the surface and in the upper layer, this soil is similar to Raynor clay, 0 to 3 percent slopes. Runoff is medium, but there is no evidence of erosion. The soil is used only for range. (Capability unit VIe–5; Storie index rating 30)

Raynor cobbly clay, 8 to 15 percent slopes (RbC).—This soil is used entirely for range. (Capability unit VIe–5; Storie index rating 28)

Redding Series

The Redding soils are on high terraces in the northern and eastern parts of the Area. The parent material was poorly sorted gravelly alluvium laid down in large fans by streams during the Sierra Nevada mountain-building period. In most places the topography is gently sloping and has a characteristic mound microrelief. The cover is grass and herbs, mainly alfileria.

These soils have an impermeable cemented hardpan. They are gravelly or cobbly. The cobblestones are concentrated in the depressions between the mounds and beneath the mounds but not in them.

The Redding soils are strongly acid. They have been strongly weathered and are leached of much of their fertility. The Corning and Anderson soils developed from similar gravelly alluvium but are more recent. The Redding and Corning soils are similar, but the Redding soils have a claypan and also a cemented hardpan in their subsoil, and the Corning soils have a claypan only. The dark-colored Keyes soils are similar to the Redding soils, but they developed from andesitic gravel.

The Redding soils occur on two main terrace levels. The soils on the very high, very old terrace south of the Merced River are more strongly leached and weathered and more strongly acid than the lower lying Redding soils. The Redding soils on the lower terraces closely resemble the Redding soils in the Sacramento and northern San Joaquin Valleys. They are gravelly and reddish brown to yellowish red. They have a pronounced red claypan at a depth of about 12 to 18 inches. The claypan rests directly on a cemented gravelly iron-silica hardpan at a depth of 18 to 24 inches. The hardpan is exceedingly dense and hard. Below the hardpan are weathered mixed gravelly sediments.

Redding gravelly loam, 0 to 8 percent slopes (ReB).—This gravelly, reddish soil has a dense claypan just above a hardpan. The relief is gently undulating, and the surface is covered with low mounds.

Representative profile:

1. The surface soil, to a depth of 14 to 20 inches, is reddish-brown to yellowish-red gravelly loam that has weak, granular structure when moist but is essentially massive when dry. The reaction is strongly acid. The lower boundary is abrupt.
2. This layer is made up of red, plastic, medium acid to strongly acid gravelly clay that has prismatic or blocky structure. In most places it has a thin, gray, bleached upper part and a mottled or gray lower part. This layer is from 3 to 10 inches thick. Its boundary is abrupt over the hardpan. The depth to the hardpan generally ranges from 18 inches to about 30 inches; it is rarely deeper.
3. The hardpan, 8 to 24 inches thick, is reddish brown or yellowish red and gravelly. It is cemented with iron and silica.
4. Below the hardpan is a mass of gravel and mottled material that is medium in texture and yellowish red in color. It shows evidence of much weathering, in some places to a depth of 30 feet but, in most places, less.

Included are areas of Corning gravelly loam. Also included are areas of gravelly sandy loam and gravelly clay loam and a few areas of gravelly San Joaquin and Rocklin soils.

This soil is well drained, but it is waterlogged for a month or two in spring in wet years. The surface soil is moderately permeable; the subsoil and hardpan are very slowly permeable. Roots cannot penetrate the hardpan layer. Runoff is slow, and the erosion hazard is slight. Fertility is low to very low. The soil is very difficult to work because of the gravel and scattered cobblestones.

The principal use of this soil is range. The range is grazed principally during the winter and spring. The higher terrace area has the lower carrying capacity. Grain has been planted in small areas in fields dominated by other soils. Fertility tests indicate that very large amounts of nitrogen, lime, and phosphate are required to produce good yields. A little irrigated pasture is grown, but the quality of the forage is only poor to fair. (Capability unit IVe–3; Storie index rating 11)

Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes (RdA).—This soil occurs near Yosemite Lake where seepage from the irrigation canals and reservoir has created a perched water table above the hardpan. It differs from Redding gravelly loam, 0 to 8 percent slopes, in being more mottled, particularly in the subsoil.

This soil is used only for range. It is wet much of the time. Grass yields are higher than on the better drained soils. (Capability unit VIe–9; Storie index rating 3)

Redding gravelly loam, 8 to 30 percent slopes (ReD).—Most areas of this soil have a slope of less than 15 percent. Surface runoff is medium. This soil absorbs less of the limited rainfall than Redding gravelly loam, 0 to 8 percent slopes, and its carrying capacity is lower. Erosion is not evident except where grazing has been particularly heavy. This soil is used entirely for range. (Capability unit VIe–9; Storie index rating 9)

Redding cobbly loam, 0 to 8 percent slopes (RcB).—The mounds on all the Redding soils are gravelly. In this soil, cobblestones from 3 to 10 inches in diameter cover the area between the mounds and are present in the hardpan below the mounds. This soil is used only for range. (Capability unit VIe–9; Storie index rating 9)

Riverwash

This miscellaneous land type is in the channels of the main streams of the Area. It consists of a mixture of sand, gravel, and in some places cobblestones. It is flooded seasonally. At frequent intervals new channels are cut, and material is washed away, redistributed, or deposited.

Riverwash (Rf).—The land in this unit lies along the larger streams. It has little or no vegetation. The sand and gravel might possibly be used for building material. Some areas may be useful for gold dredging, but otherwise they are of no value. (Capability unit VIIIs–1; Storie index rating less than 5)

Rock Land

Some areas contain many outcrops of rock and very little soil. These areas have been mapped as miscellaneous land types. Some of them may be used as sources of building stone. They are almost useless for agriculture.

Sandstone rock land (Sa).—This miscellaneous land type is associated with the Hornitos and Amador soils. It consists of almost bare outcrops and buttes of sandstone. The sandstone weathers to form angular, almost cubical, blocks about 4 to 12 inches in size. These blocky fragments cover the surface in some areas. There is only a little soil material in crevices. The vegetation is a sparse growth of grass and a few scrub oaks.

These rocky areas are of little or no agricultural value. The yellow, white, and pink sandstone, which in many places has an interesting mottled pattern, is being quarried for building stone. In the early days of California, many rock fences were built of this stone. A few along the foothills are still in use. (Capability unit VIIIs–1; Storie index rating less than 5)

Schist rock land (Se).—This miscellaneous land type is associated with the Auburn and Exchequer soils. It consists of rocky areas that have little or no true soil except in cracks and crevices. It is made up of greenstone and porphyritic schist that have a steeply dipping cleavage. When weathered, they leave large plates of rock standing on edge, thus the local name, tombstone land. Many white quartz dikes are included.

These areas support only a little grass and a few oaks. They are of little or no value even for range. (Capability unit VIIIs–1; Storie index rating less than 5)

Slate rock land (Sh).—This miscellaneous land type consists chiefly of slate and schist outcrops. These stand out as thin platy ledges, almost on edge because of the nearly vertical cleavage of the rock. There is almost no true soil in these areas. This land type has little agricultural value. The rock has been quarried for roofing slate, but the project has been long abandoned. (Capability unit VIIIs–1; Storie index rating less than 5)

Tuff rock land (Tr).—This miscellaneous land type consists of outcrops of tuffaceous rock in areas of Amador soils. This rock is massive and weathers to irregular shapes. Pockets and smooth spots are covered with small, yellow, angular fragments about ½ to 1 centimeter long, characteristic of the weathering of the rhyolitic tuff material. This land type has little or no agricultural value. (Capability unit VIIIs–1; Storie index rating less than 5)

Rocklin Series

The Rocklin soils occur on well-drained, undulating to gently rolling topography north of the Merced River. They have a thin, cemented hardpan that effectively stops root and water penetration. The parent material consisted of weakly consolidated granitic sediments that ranged from fine sandy loam to silt loam in texture. The cover is grass and small herbs, mainly alfileria.

These soils are strongly weathered. They are similar to the San Joaquin soils, except that they have less clay in the subsoil, have a thin hardpan, and have a finer textured and more compact substratum. The material from which the Rocklin soils developed was formerly buried beneath a mantle of coarse sandy alluvium of the type from which the Montpellier soils formed. Where erosion has only partly removed the sands, the Rocklin soils are closely associated with the Montpellier soils. On slightly steeper slopes where the soils have been recently dissected, the Whitney soils, which are less weathered than the Rocklin, have developed. The rate of dissection of this area varies from one drainageway to the next, resulting in a complex of soils of different degrees of weathering. Within short distances, there is a range from strongly developed soils to almost unweathered outcrops of parent material, with soils of varying degrees of development in between.

Rocklin loam, 0 to 3 percent slopes (RgA).—This soil lies on undulating, partly dissected terraces in the northern part of the Area.

Representative profile:

1. The surface soil, to a depth of 7 to 12 inches, consists of brown (nearly reddish-brown), slightly acid loam. It is slightly hard when dry and friable when moist. It has a weak, granular structure when moist, but it is essentially massive when dry. This layer is low in organic matter. The transition to the layer below is clear.
2. The upper subsoil is generally strong-brown to reddish-brown clay loam. It is hard when dry but friable when moist. It is 10 to 18 inches thick. It has moderate, subangular blocky structure. The reaction is neutral to slightly acid. The lower boundary is abrupt.
3. The reddish-brown to yellowish-red hardpan in this layer is cemented with iron and silica. It is slightly platy in structure. It is impermeable to roots and water. The hardpan, in most places, is ½ inch to 4 inches thick and grades into the parent material below.
4. This layer is made up of stratified beds of well-sorted, light-gray fine sand and silt many feet thick. The material is micaceous and weakly consolidated. It is similar to that beneath the Whitney soils. In some places, lime is present in seams of the hardpan and for a short distance below.

The thickness and distinctness of the layers vary greatly. The soil characteristics range from those typical of the strongly weathered San Joaquin hardpan soils to those of the relatively slightly weathered Whitney soils. Included are areas that have a surface soil of fine sandy loam.

This soil is well drained and moderately permeable, except for the impermeable hardpan. It remains saturated for a month or two in spring in wet years. The water-holding capacity is low. Surface runoff is slow, and the erosion hazard is slight. Fertility is low. This soil is easy to work, but a plowpan forms readily if the soil is worked when too moist.

Most areas are dryfarmed to grain in a rotation of alternate grain and fallow. Pronounced increases in yields result when both nitrogen and phosphorus fertilizers are added and moisture is adequate. Sulfur is needed for legumes. The hardpan makes the growing of deep-rooted crops, such as orchard crops, a poor risk, even where water is available for irrigation. A small acreage in irrigated ladino clover-grass pasture has been successful where leveling has not removed too much of the surface material. Where large areas of hardpan are exposed, plant growth is poor. (Capability unit IVs–3; Storie index rating 43)

Rocklin loam, 3 to 8 percent slopes (RgB).—Except for the moderate erosion hazard, this soil is similar to Rock-

lin loam, 0 to 3 percent slopes. Dryfarmed grain is the principal crop, and some irrigated ladino clover-grass pasture is grown. The soil is plowed in the fallow year, and rill erosion shows in some places after a heavy rain. Leveling for irrigation is difficult because the soil is so shallow over hardpan. (Capability unit IVe–3; Storie index rating 41)

Rocklin loam, 8 to 15 percent slopes (RgC).—This soil is not extensive. Most areas show evidence of slight erosion, and in some places the subsoil is exposed. Contour cultivation and stripcropping should be used wherever possible to control erosion. (Capability unit IVe–3; Storie index rating 26)

Rocklin sandy loam, 0 to 3 percent slopes (RkA).—This soil is similar to Rocklin loam, 0 to 3 percent slopes, but it is coarser textured throughout, and it has a pale-brown to light reddish-brown surface soil. The moisture-holding capacity is a little lower. The hazard of erosion, both by wind and water, is greater on all but the gentlest slopes.

This soil is used in much the same way as Rocklin loam, 0 to 3 percent slopes. Regular cultivation during the fallow year leaves the surface layer loose and susceptible to wind erosion. Where the soil blows, farming and cultivating at right angles to the wind, in a pattern similar to stripcropping, will reduce soil losses. Stubble-mulch farming might help to conserve moisture as well as protect the soil. Dryfarmed grain and irrigated pasture of ladino clover and grass appear to be the best crops for this soil. (Capability unit IVs–3; Storie index rating 41)

Rocklin sandy loam, 3 to 8 percent slopes (RkB).—This soil is used in the same way as Rocklin sandy loam, 0 to 3 percent slopes. The erosion hazard is moderate. Practices that will reduce erosion should be adopted. (Capability unit IVe–3; Storie index rating 38)

Rocklin sandy loam, 3 to 8 percent slopes, eroded (RkB2).—This soil generally occurs as small spots within large fields of other soils. It was originally like Rocklin sandy loam, 0 to 3 percent slopes, but it has been eroded sufficiently in places to expose the redder subsurface and subsoil layers. The moisture-holding capacity is reduced, and runoff has increased to medium.

Little can be done to restore the soil once erosion has cut away the surface layers, but further damage can be prevented. These areas should not be cultivated except at long intervals. Some eroded fine sandy loams are included. (Capability unit IVe–3; Storie index rating 30)

Rocklin sandy loam, 8 to 15 percent slopes, eroded (RkC2).—Almost all of these rolling areas are eroded to some degree. Many spots of the reddish subsoil are exposed, and the hardpan outcrops in places. The erosion ranges from very slight to moderately severe. It consists of rill and sheet erosion, with only a few shallow gullies. The soil depth generally ranges from 12 to 18 inches. The water-holding capacity is very low. Runoff is medium to rapid. To control erosion either contour cultivation or stripcropping should be used, if possible, together with some system of cover cropping, stubble-mulch farming, or a rotation that leaves the soil exposed only a small part of the time. Barley alternated with fallow is the principal use for this soil, but range is its best use. (Capability unit VIe–9; Storie index rating 26)

Rossi Series

The soils of the Rossi series are in the nearly level basin area adjacent to the flood plain of the San Joaquin River. They lie just above the flood level. They are poorly drained, dark-colored, saline-alkali soils developed from alluvium of somewhat mixed but predominantly granitic origin. The vegetation is mainly saltgrass and salt-tolerant herbs.

The surface soil consists of gray, blocky clay loam or clay. It is slightly calcareous and contains variable amounts of salts. The subsoil is olive-gray to light-gray, strongly alkaline clay that has a subangular blocky structure. Below a depth of 24 inches there is a considerable accumulation of nodular lime concretions. The texture grades to clay loam and then to sandy loam at greater depths. The water table is normally 2 to 4 feet below the surface.

The Rossi soils are closely related to the Chino soils that are mapped in nearby counties, but they have a shallower surface soil and an olive-gray to light-gray subsoil containing more lime and clay. The more recently formed and frequently flooded Merced and Temple soils contain less salts and alkali.

Rossi clay, moderately saline-alkali, 0 to 1 percent slopes (RmA).—This soil occurs on nearly level topography along the edge of the San Joaquin River flood plain, slightly above the general flood level. It is poorly drained and subject to a high water table. It is flooded on very rare occasions.

Representative profile:

1. The surface soil, to a depth of 6 to 10 inches, is gray to dark-gray clay that is sticky when wet and dries to form very hard blocks. Salts are normally not concentrated at the immediate surface, but this layer is slightly calcareous and moderately alkaline.
2. The subsoil, to a depth of about 24 inches, is clay, olive gray when dry, olive when moist. It is very sticky and very plastic when wet. It has strong, medium, blocky structure. Salts are concentrated in this layer, which is generally strongly alkaline. A few saltgrass roots grow in the cracks. The lower subsoil, to a depth of about 3 feet, is light gray and contains strong concentrations of segregated lime and salts. This layer is more friable, and the blocky structure is less distinct than in the layer above.
3. In this layer are yellowish-brown, massive, moderately calcareous, strongly alkaline, moderately fine textured sediments. Lime nodules are common. A water table is normally between 2 and 4 feet below the surface, but at times it fluctuates almost to the surface.

In some places, the surface layer is almost free of salts; in others, salts are strongly concentrated.

This soil is associated with the more frequently flooded Merced and Temple soils, and a few narrow channels of those soils are included.

This soil is poorly drained and very slowly permeable. Runoff is very slow; the soil is ponded at times. Roots rarely penetrate below the surface layer. The soil is difficult to work and usually forms very hard clods when tilled.

If this soil is examined superficially without regard to the moderate concentrations of salts and alkali, it gives the impression of being fairly fertile and workable in its natural state. As a consequence, there have been several unsuccessful attempts to grow crops. If the water table

can be lowered permanently, reclamation may be worth while, but at present the quality of the soil does not justify the cost of reclamation. The best use at the present time is range. The grasses furnish fair amounts of feed. (Capability unit VIw–6; Storie index rating 11)

Rossi clay, strongly saline-alkali, 0 to 1 percent slopes (RnA).—This soil is not suitable for cultivation. Reclamation is not practical under present conditions. Range is the best use, even though the forage from the sparse saltgrass cover is limited. (Capability unit VIw–6; Storie index rating 4)

Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes (RoA).—This soil is similar to Rossi clay, moderately saline-alkali, 0 to 1 percent slopes, but its surface soil contains less clay, is not so hard when dry, and is less sticky when wet. In some areas bordering the Merced soils, the immediate surface is almost free of salts and is only mildly alkaline in reaction.

This soil can be used for dryfarmed grain. With careful irrigation, drainage, additions of gypsum or sulfur, and flooding to leach the salts, this soil can be used for salt- and alkali-tolerant crops, such as rice, cotton, sugar beets, and alfalfa. It is of marginal quality, however, because of the clayey, slowly permeable, strongly calcareous subsoil and the content of salts and alkali; and the costs of leveling, irrigation, and reclamation should be carefully considered. Care is needed in leveling to avoid exposing the subsoil. (Capability unit IIIw–6; Storie index rating 36)

Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes (RpA).—This soil is associated with broad areas of Merced soils. It has a very slowly permeable subsoil. Most of the area is used only for range. Reclamation is possible, but costs should be carefully considered. (Capability unit IVw–6; Storie index rating 15)

Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes (RrA).—Except for the texture of the surface layer, this soil is similar to Rossi clay, strongly saline-alkali, 0 to 1 percent slopes. The two soils are used and managed in about the same way. (Capability unit VIw–6; Storie index rating 5)

Ryer Series

The Ryer soils are on nearly level or gently sloping terraces along Dry Creek and Burns Creek and in areas near Merced, Planada, and Le Grand. These soils are well drained except in small depressions. The parent material was fine sandy or silty alluvium derived mostly from basic igneous rocks but including some material derived from sedimentary rocks. The vegetation is mainly grass and a few widely scattered oaks.

The Honcut and Wyman soils developed from the same kind of parent material as the Ryer, but they are younger and less strongly developed. The Yokohl soils, from the same kind of material, are older and more strongly developed; they have a hardpan in their subsoil. In some places in this Area, the Honcut, Wyman, Ryer, and Yokohl soils occur in that order on a series of alluvial fans and terraces.

The surface soil consists of 12 to 20 inches of pale-brown, friable silt loam or clay loam, slightly acid in reaction and having a weak granular structure. This layer rests rather abruptly upon a thick layer of very hard, blocky, brown clay or heavy clay loam, neutral in the upper part and mildy alkaline with specks and small spots of lime in the lower part. Roots and water penetrate this layer, but with some difficulty, as indicated by the slight concentration of roots in cracks. Below a depth of about 48 inches the soil grades into coarser textured parent material, which is stratified and slightly mottled with a few spots of lime that disappear below a depth of about 6 feet.

Ryer silt loam, 0 to 3 percent slopes (RtA).—Most of this soil occurs on very gently sloping terraces along Dry Creek and Burns Creek. Smaller areas are along Bear Creek.

Representative profile:

1. The surface soil, to a depth of 10 to 20 inches, is pale-brown, slightly acid silt loam. It is hard when dry, but friable when moist. It has weak, granular structure when moist, but it is essentially massive when dry. This layer is low in organic matter. The transition to the subsoil below is clear.
2. The subsoil of brown heavy clay loam or light clay may be as much as 28 inches thick. It has blocky structure. The blocks are coated with dark-brown colloidal material. This layer is very hard when dry, firm when moist, and sticky and plastic when wet. It is mildly alkaline and intermittently calcareous.
3. This layer, 40 to 50 inches below the surface, is made up of massive, intermittently calcareous, firm clay loam that is slightly stratified with coarser material. It is faintly mottled in places.

Included are areas that have loam or very fine sandy loam surface soils. The soil near the eastern part of the Dry Creek terrace has a little gravel in the profile.

This soil is well drained. The surface soil is moderately permeable; the subsoil is slowly permeable. Surface runoff is slow. There is a slight hazard of erosion. Fertility is moderate, and the water-holding capacity is high. The soil is easily worked and can be irrigated without difficulty.

About half of this soil is cultivated; the rest is used for range. The cultivated part is chiefly in dryfarmed grain. A small acreage of alfalfa and pasture is irrigated. Most of this soil could be irrigated if water were available. Possible uses include most field crops, grapes, almonds, peaches, and other orchard crops. Yields should be only slightly less than for the Wyman soils. (Capability unit IIs–7; Storie index rating 85)

Ryer clay loam, 0 to 3 percent slopes (RsA).—This soil has a finer texture and a slightly less permeable surface layer than Ryer silt loam, 0 to 3 percent slopes.

Included with this soil are a few small, imperfectly drained areas of plastic clay. Small depressions where the soil is slowly permeable are common.

This soil is used and managed in much the same way as Ryer silt loam, 0 to 3 percent slopes. It cannot, however, be cultivated over so wide a range of moisture content. If it is worked when too wet, the infiltration rate is reduced, because the surface layer puddles and dries into hard clods, and a dense plowsole forms. (Capability unit IIs–7; Storie index rating 77)

Ryer clay loam, 3 to 8 percent slopes (RsB).—This soil has a finer surface texture than Ryer silt loam, 0 to 3 percent slopes. Gullies tend to form when water runs across these areas from higher lying areas. This soil cannot be irrigated conveniently and should probably be left in dryfarmed grain. (Capability unit IIs–7; Storie index rating 69)

San Joaquin Series

The San Joaquin soils occur on old fans and terraces of granitic alluvium laid down by the Merced and Chowchilla Rivers. They are well drained, but internal drainage is very slow because there is a hardpan in the subsoil. The topography is gently undulating, with a distinct mound, or hogwallow, microrelief. The vegetation consists of grass and herbs, mainly alfileria.

These soils are old and strongly weathered. A reddish claypan overlies the hardpan.

In many places, the Snelling and Montpellier soils are associated with the San Joaquin soils. The Snelling soils contain less subsoil clay and no hardpan. The Montpellier soils contain a claypan subsoil without a hardpan. The Alamo soils are intricately associated with the San Joaquin soils; they lie in small depressions.

San Joaquin sandy loam, 0 to 3 percent slopes (ScA).—This soil occurs southeast of Le Grand and also north of Merced. It commonly has a mound microrelief. Where it is cultivated, many of the mounds have been flattened and the depressions partly filled.

Representative profile:

1. The surface soil, to a depth of 6 to 9 inches, is light reddish-brown to reddish-brown, hard, slightly acid sandy loam. It is friable when moist. It is low in organic matter. The structure is weak granular when moist, and essentially massive when dry. The soil below, to a depth of about 13 inches, is reddish brown when moist, and browner when dry. It is slightly finer in texture and slightly sticky when moist. The transition to the subsoil is distinct.
2. The upper subsoil is reddish-brown, hard, blocky sandy clay loam. The reaction is slightly acid. This layer is about 3 to 6 inches thick. The boundary is abrupt over the claypan.
3. This layer is reddish-brown, neutral clay or gritty clay that has blocky or prismatic structure. It is very hard when dry, firm when moist, and very plastic and very sticky when wet. It is 2 to 6 inches thick. The transition to the hardpan is abrupt.
4. The reddish-brown or brownish-red iron-silica hardpan is indurated into a rock-hard layer. A mat of roots coats the upper surface in many places. The lower part of the pan grades into softer material. The hardpan ranges from 6 to 16 inches in thickness. It may have a little lime in seams.
5. The material below the hardpan is gritty, stratified, granitic alluvium. It is firm in the upper part and becomes more friable with increasing depth. It is generally brown or yellowish brown in color.

The claypan is very thin in many places. In places it has a medium, prismatic structure. The hardpan is likely to be thicker and harder under the depressions and slightly thinner under the mounds. The soil may or may not be thicker on the mounds than in the depressions. Included are areas of fine sandy loam that in some places is slightly redder when dry. Small spots of Alamo clay also are included.

This soil is well drained, but it remains saturated above the hardpan for a month or two in wet years. The surface layer is moderately permeable; the hardpan is almost impermeable. Runoff is slow. There is little or no hazard of erosion. The water-holding capacity and fertility are low.

This soil is better suited to extensive farming than to intensive cropping. Grain farms range in size from half a square mile to several square miles, and many fields are more than 1,000 acres in size. This soil is used mostly for dryfarmed grain; it is also used for irrigated pasture and field crops, olives, and range. The principal crop is dryfarmed barley in rotation with fallow. The soil is limited by shallowness over the hardpan and by deficiencies of phosphorus and nitrogen. (Capability unit IVs–3; Storie index rating 24)

San Joaquin sandy loam, 3 to 8 percent slopes (ScB).—This soil has about the same use and management problems as San Joaquin sandy loam, 0 to 3 percent slopes. Runoff is medium and the erosion hazard is moderate, however, and more care is needed to control erosion. The reddish subsoil is exposed in places. Rills can be observed after a heavy rain. In some areas, contour cultivation or stripcropping might control erosion; in others, stubble mulching or a crop rotation might give better protection. (Capability unit IVe–3; Storie index rating 22)

San Joaquin loam, 0 to 3 percent slopes (SbA).—This soil is finer textured and slightly redder than San Joaquin sandy loam, 0 to 3 percent slopes. In addition, the claypan in many places is thicker and closer to the surface. The hardpan lies at a depth of 14 to 24 inches. Small spots of Alamo clay are included.

This soil is used and managed in much the same way as San Joaquin sandy loam, 0 to 3 percent slopes, but, to keep it friable and prevent the formation of a plowsole, it should be allowed a little more time to dry out after a rain. A plowsole is common in this soil. Because the included spots of Alamo soil remain wet longer, they often cause difficulty in tillage. (Capability unit IVs–3; Storie index rating 25)

San Joaquin loam, 3 to 8 percent slopes (SbB).—Except for its finer surface texture, this soil is similar to San Joaquin sandy loam, 3 to 8 percent slopes. It is similar in use and management also. (Capability unit IVe–3; Storie index rating 24)

San Joaquin-Alamo complex, 0 to 3 percent slopes (SdA).—This complex is mapped where San Joaquin sandy loam occurs in an intricate pattern with spots of Alamo clay. From 20 to 40 percent of the unit consists of the Alamo soil. The soils are too closely associated to be farmed separately, and management must be a compromise between the requirements of the two soils. The soil materials are often mixed by leveling. Cultivation should be guided by the moisture content of the Alamo clay, even when the San Joaquin soil has become too dry to cultivate easily.

Both soils are relatively infertile and shallow; therefore, intensive farming is not advisable. They are used only for dryfarmed grain and a little irrigated pasture. (Capability unit IVs–3; Storie index rating 20)

Sesame Series

The Sesame soils developed in place from partly decomposed granodiorite. They occur to a very limited extent in the foothills along the Mariposa County line. The topography is gently rolling to hilly. The vegetation is mainly grass and a few scattered small oaks. The profile generally consists of 8 to 12 inches of gritty, slightly acid, dark-brown loam that grades into a dark-brown, blocky, gritty sandy clay loam. This layer is about neutral to mildly alkaline and in a few areas slightly calcareous. At a depth of 14 to 24 inches, the subsoil grades irregularly into yellowish-brown to reddish-brown,

weathered granodiorite that has been metamorphosed into a slightly schistose structure. Many dikes of quartz are included.

These soils are associated with the Whiterock soils, which developed from hard metasediments, and the Hornitos soils, which formed from sandstone. The Sesame soils are related to the Vista soils but are distinguished from them by the dark-brown color and the more pronounced accumulation of clay in the subsoil.

Sesame rocky loam, 3 to 8 percent slopes (SfB).—This dark-brown soil has scattered outcrops of rock. The topography is undulating. A few small areas lie along the Mariposa County line between Burns Creek and the Chowchilla River.

Representative profile:

1. The surface soil, to a depth of about 8 inches, consists of hard, slightly acid, dark-brown to dark grayish-brown loam that contains considerable coarse grit. It has weak, granular structure when moist, and is essentially massive when dry. It grades into the subsoil.
2. The subsoil, about 8 to 16 inches thick, consists of dark-brown, neutral sandy clay loam that is slightly more clayey in the lower part. It contains a little lime in some areas. In some places it has a thin layer of very sticky clay just above the bedrock. Irregular rock fragments are in the lower subsoil, and slightly weathered hard rock lies at a depth of about 20 inches.
3. The parent material is partly decomposed granodiorite.

The soil in some areas has a deeper profile and a more pronounced reddish-brown clay subsoil that generally contains a little lime. Dikes of white quartz rock are common.

This soil is well drained and moderately permeable throughout. Runoff is medium, and the erosion hazard is moderate. The effective root zone is moderately deep. The water-holding capacity is low. The soil is moderately difficult to work because of the rock outcrops. It has moderate fertility.

This soil is used almost entirely for range, although small areas are included in fields of dryfarmed grain. The grain does reasonably well. (Capability unit VIe-4; Storie index rating 29)

Sesame rocky loam, 8 to 30 percent slopes (SfD).—This soil is similar to Sesame rocky loam, 3 to 8 percent slopes, except that it has stronger slopes, rapid runoff, and a severe erosion hazard. It should be used only for range, for which it is well suited. (Capability unit VIe-4; Storie index rating 24)

Seville Series

The Seville soils occur on gently sloping low terraces near Planada and Le Grand. They are clay soils that have a lime-cemented hardpan in the subsoil. The parent material is strongly alkaline alluvium derived from basic igneous rocks. The cover is grass and burclover.

The associated Porterville soils have a layer of lime accumulation in the subsoil, but no cemented hardpan. The brown Hopeton soils have still less lime, and the Raynor soils are dark colored and have only a moderate amount of lime in the subsoil.

The profile generally consists of a dark reddish-brown, slightly calcareous clay that dries to a coarse blocky structure, then forms an extremely hard fine blocky or granular structure by secondary cracking. The lime is generally nodular and is more abundant with increasing depth, giving the lower part of the soil a mottled appearance. This layer rests abruptly upon a white, lime-cemented hardpan that ranges from strongly cemented to nodular within short distances and is from 2 to 6 inches in thickness. Below the hardpan is a pale-brown, strongly alkaline clay loam that contains thin lenses of cemented lime. This material becomes coarser textured and decreases slightly in lime content at greater depths.

Seville clay, 0 to 3 percent slopes (SgA).—This soil lies on gentle slopes near Le Grand and Planada.

Representative profile:

1. The surface soil, to a depth of about 12 to 18 inches, is dark reddish-brown, slightly calcareous clay. When it is dry, it forms coarse blocks that are separated by wide cracks. The immediate surface often dries to fine, blocky structure. This layer is very sticky when wet, extremely hard when dry. Nodules of lime are common on the surface.
2. The subsoil is similar, but has medium, blocky structure. It contains many nodules and blotches of lime. It rests upon the hardpan at a depth of 18 to 30 inches.
3. The hardpan is made up of almost white, platy, marly material that is strongly cemented in many places but is nodular in many others. The hardpan can be easily broken with a chisel drawn by a large tractor.
4. Below the hardpan are pale-brown, massive sediments of clay loam that are moderately calcareous and strongly alkaline.

Included are areas of Porterville clay and areas of dark-gray soils that probably contain some sedimentary material.

This soil is well drained. It is very slowly permeable, except when it is dry and has large cracks. Surface runoff is slow. There is little or no hazard of erosion. The soil has a high water-holding capacity. It is low in fertility, especially in available phosphorus. It is difficult to work because of its fine texture, but not so difficult as other clay soils.

This soil is limited by its fine texture, strongly calcareous subsoil, and hardpan. In use and management it is much the same as Porterville clay, 0 to 3 percent slopes. Most areas are used for range, dryfarmed grain, and irrigated pasture, and a few areas are in figs. (Capability unit IIIs-5; Storie index rating 24)

Seville clay, 3 to 8 percent slopes (SgB).—This soil is similar in use and management to Porterville clay, 3 to 8 percent slopes. (Capability unit IIIs-5; Storie index rating 23)

Slickens

This miscellaneous land type consists of beds of silt that accumulated in ponds where gold was being dredged.

Slickens (Sk).—There are only a few acres of this miscellaneous land type; they lie northeast of Snelling. The material is silt that settled in still water as a result of gold-dredging operations. It is stratified and slightly calcareous. It is very smooth and sticky.

These areas have been planted to clover. They produce excellent irrigated pasture. (Capability unit I-1; Storie index rating 80)

Snelling Series

The Snelling soils occur mainly on nearly level or gently sloping alluvial terraces along the Merced River

near Snelling and Hopeton. These are well-drained soils formed from granitic alluvium. The cover is grass, small herbs—mainly alfileria—and a few widely scattered oaks.

The surface soil is pale-brown, slightly acid sandy loam, the subsoil is brown, hard, weakly prismatic to massive, slightly acid sandy clay loam, and the substratum is stratified sandy loam and sand. Although the subsoil is hard and dense when thoroughly dry, water and roots penetrate it without great difficulty.

In places the Snelling soils are associated with the Greenfield soils, which are at the same level on the terraces.

Snelling sandy loam, 0 to 3 percent slopes (SnA).—This soil occupies nearly level to undulating, alluvial terraces of the Merced River near Snelling.

Representative profile:

1. The surface soil, to a depth of about 22 inches, is slightly acid, gritty sandy loam, pale brown when dry but grayish brown when moist. It has weak, granular structure when moist and is essentially massive and slightly hard when dry. It grades into the subsoil.
2. The subsoil is brown, slightly acid, light sandy clay loam. Its structure is weak, prismatic to massive. It is hard when dry and slightly sticky when wet. This layer, about 2 feet thick, grades into the parent material.
3. Below a depth of about 4 feet are light-brown, slightly stratified loamy sand and sandy loam. The reaction is about neutral.

Included are a few areas of loamy sand that have been slightly affected by wind erosion.

This soil is well drained. Permeability is rapid in the surface soil and moderate in the subsoil. Surface runoff is slow. There is little erosion hazard except for a slight danger of wind movement. The soil is easy to work and has a moderate water-holding capacity.

Much of this soil is irrigated and used for grapes, alfalfa, ladino clover, and tree crops. A large area south of the river is used only for dryfarmed grain. A few acres are planted to almonds, which are not irrigated. This soil is well suited to irrigation. The supply of nitrogen is low, and the soil is also deficient in phosphorus and sulfur, especially for legumes. The response to fertilization should be good. (Capability unit IIs–7; Storie index rating 85)

Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes (SmA).—This soil lies southeast of Atwater. It is affected slightly by a high water table resulting from irrigation and impeded drainage due to buried hardpan soils. The subsoil is faintly mottled. The water table is occasionally in the lower part of the subsoil. In places sand has been added to the surface by the wind.

This soil can be used successfully for field crops, alfalfa, and irrigated pasture but is poorly suited to fruit trees. (Capability unit IIIw–2; Storie index rating 56)

Snelling sandy loam, 3 to 8 percent slopes (SnB).—About half of this soil is irrigated; the rest is used for dryfarmed grain and a few fields of unirrigated almonds. Planting and irrigating on the contour and other measures to slow water movement and prevent erosion are needed. (Capability unit IIs–7; Storie index rating 77)

Snelling sandy loam, 3 to 8 percent slopes, eroded (SnB2).—This soil is used mainly for dryfarmed grain. It has shallow gullies, and the brown sandy clay loam subsoil is exposed in many spots. Runoff is medium, and the erosion hazard is moderate. Crop rotation or practices such as stripcropping or cultivating and planting on the contour are needed to protect the soil from further erosion and decline in productivity. (Capability unit IIIe–1; Storie index rating 62)

Snelling sandy loam, 8 to 15 percent slopes (SnC).—This soil has a severe erosion hazard. Crop rotations or practices such as stripcropping or cultivating and planting on the contour are needed to protect the soil from erosion. (Capability unit IVe–1; Storie index rating 68)

Snelling sandy loam, 8 to 15 percent slopes, eroded (SnC2).—This soil was originally similar to Snelling sandy loam, 0 to 3 percent slopes. However, much of the surface layer has been lost by erosion, and shallow gullies are common. Runoff is rapid, and the erosion hazard is severe. Erosion control practices and the addition of organic matter and fertilizers are needed to restore this soil to profitable production. (Capability unit IVe–1; Storie index rating 55)

Snelling sandy loam, 15 to 30 percent slopes, eroded (SnD2).—This soil occurs on sharply dissected terrace escarpments. It needs a protective plant cover most of the time to reduce further erosion. Cultivation is moderately difficult. (Capability unit VIe–4; Storie index rating 42)

Tailings

Tailings consists of the gravel and other debris discarded during operations of the gold dredgers. Soil and rock materials from the soil and its underlying alluvial substrata have been mixed and dumped in rough piles on the surface (fig. 13).

Tailings (Ta).—This miscellaneous land type consists of piles of gravel and cobblestones in areas of bottom land that were formerly occupied mainly by Grangeville and Hanford soils. Intermittent ponds stand in depressions between gravel heaps.

These areas formerly produced large yields of crops, but they are now useless for agriculture. (Capability unit VIIIs–1; Storie index rating 0)

Temple Series

The Temple soils occur on the San Joaquin River flood plain in poorly drained, nearly level or depressed areas

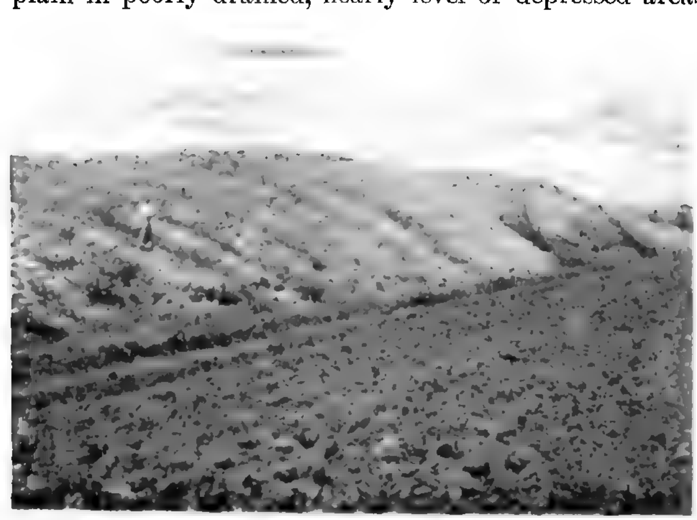

Figure 13.—**Tailings left by gold dredgers. Grangeville loam, 0 to 1 percent slopes, in the foreground.**

that are frequently flooded. The parent material is medium-textured alluvium derived from mixed rock, mostly granitic. The subsoil is more clayey than the surface soil. It contains considerable lime and, in many places, excess neutral salts. The vegetation consists of grasses, rushes, and lippia, with willows along channelways.

The dark-gray loam or clay loam surface soil has a high organic-matter content, weak granular structure, and neutral to mildly alkaline reaction. The olive-gray, calcareous, sandy clay loam subsoil becomes strongly calcareous between depths of about 24 and 48 inches. It is firm but easily penetrated by roots and water. Below the subsoil the lime content and clay content decrease. The mottled, pale-olive, fine sandy loam parent material is at a depth of about 4 feet.

Associated soils are the mottled, brown Columbia soils and the more strongly weathered Merced soils, which are less friable, lower in organic matter, and of lower agricultural value.

Temple loam, 0 to 1 percent slopes (TeA).—This dark-colored soil lies on the San Joaquin River flood plain. It is sometimes flooded, except where protected by levees. Representative profile:

1. The surface soil, to a depth of 8 to 14 inches, is dark-gray, slightly acid, granular loam. It is hard when dry and friable when moist. It is high in organic matter.
2. The upper part of the subsoil is gray clay loam that has weak, blocky structure. It is hard when dry, friable when moist, and plastic and slightly sticky when wet. The reaction is slightly calcareous; the amount of lime increases in the lower part. The lower part, to a depth of about 50 inches, is light olive-gray, strongly calcareous clay loam.
3. Below a depth of about 50 inches are slightly calcareous, pale-olive sediments of micaceous fine sandy loam.

A few small areas of Piper, Columbia, and Merced soils are included with this soil.

This soil is poorly drained and moderately permeable throughout. It has a high water-holding capacity. The depth to the water table fluctuates between 2 and 6 feet. There is no erosion hazard. The soil is easy to cultivate and irrigate.

Most of this soil is leveled and cultivated to cotton, sugar beets, grain, and alfalfa. About 25 percent is used only for range. Yields of cotton and other field crops are high. Because the soil is poorly drained, it is not advisable to plant deep-rooted crops such as orchard trees. (Capability unit IIw–2; Storie index rating 76)

Temple loam, slightly saline, 0 to 1 percent slopes (TfA).—This soil is poorly drained. Where drainage has been improved by ditches, yields of salt-tolerant crops such as cotton and alfalfa are almost as high as those on Temple loam, 0 to 1 percent slopes. Irrigation practices designed to leach the salts downward and keep the soil moist should eventually remove most of the salts without special flooding. (Capability unit IIw–2; Storie index rating 73)

Temple clay loam, 0 to 1 percent slopes (TbA).—The surface layer of this soil is silty in many places. It is easy to work. In use and management it is similar to Temple loam, 0 to 1 percent slopes. (Capability unit IIw–2; Storie index rating 69)

Temple clay loam, slightly saline, 0 to 1 percent slopes (TcA).—This soil is similar to Temple loam, slightly saline, 0 to 1 percent slopes, in use and management. (Capability unit IIw–2; Storie index rating 62)

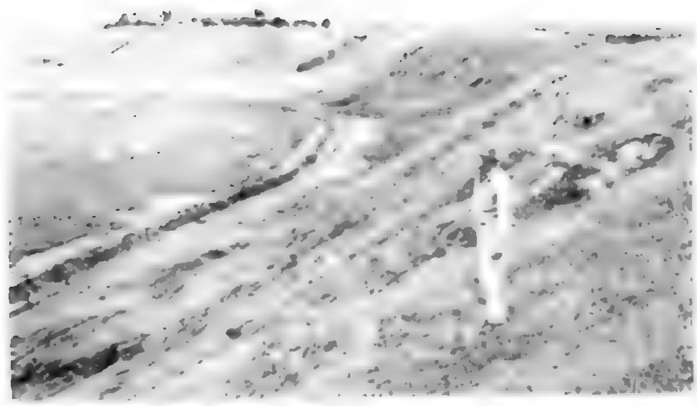

***Figure 14.*—Terrace escarpment between Snelling sandy loam, 0 to 3 percent slopes, on the terraces, and Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes, on the bottom land. The value of Terrace escarpments for grazing is limited by the danger of gully erosion.**

Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes (TdA).—This soil occurs near the San Joaquin River. It is so channeled that it is difficult to cultivate without extensive leveling. Since floods have been fairly well controlled by the Friant Dam, leveling some areas that are within larger areas of more level soil may be profitable. Leveling a field that consists entirely of this soil is costly. There is a moderate hazard of channel erosion during major floods. (Capability unit IIIw–2; Storie index rating 51)

Terrace Escarpments

This miscellaneous land type consists of the steep breaks at the edge of distinct terraces. The materials are generally unconsolidated, but these escarpments have some outcrops of tuff and sandstone along the base.

Terrace escarpments (Tg).—Most areas of this miscellaneous land type are along the edges of the Merced River flood plain; some are along Dry Creek and other streams. The slope ranges from 20 to 50 percent (fig. 14).

These areas have very little value. Except for some outcrops of tuff and sandstone along the base of the escarpments, they consist of unconsolidated material, which is extremely likely to erode. Deep gullies form quickly if irrigation water or rainfall is diverted over these areas without using pipes or protected drainageways. Most of these areas should not be farmed or grazed at all. Capability unit VIIIs–1; Storie index rating 5)

Traver Series

The Traver soils are on alluvial fans of granitic material laid down by the Chowchilla River, Dutchman Creek, and the Merced River. The topography is nearly level except for the mound, or hogwallow, microrelief. The vegetation includes saltgrass, foxtail, and other salt-tolerant plants. Drainage is good.

Figure 15.—**Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes, produces very little unirrigated pasture.**

These soils are slightly weathered and have only a little accumulation of clay in the subsoil. The medium-textured surface soil grades into a weak subangular blocky or prismatic subsoil. This grades into the friable sandy loam or fine sandy loam parent material.

Slight to strong concentrations of salts and alkali are characteristic of these soils. The reaction is strongly alkaline throughout. Many areas are puffy, encrusted with salt, and barren of vegetation. Black or dark-brown organic stains are common around puddles and in seams in the soil.

The Traver soils are associated with the Fresno and Waukena soils, but they have less clay in the subsoil, and they have no cemented lime-silica hardpan. Southeast of Stevinson, they grade into Hilmar soils, which are sandier and subject to considerable wind erosion and deposition.

Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (TnA).—This light-colored soil occurs mostly in the saline-alkali basins in the southern and western part of the Area on the alluvial fans of the Merced and Chowchilla Rivers.

Representative profile:

1. The surface soil, to a depth of 12 to 24 inches, is slightly calcareous, alkaline fine sandy loam. It is light brownish gray and hard when dry, and becomes grayish brown and friable when moist. It puddles easily and forms a slick surface that dries into a hard crust. The surface layer has a gradual lower boundary.
2. The color of the subsoil is like that of the layer above. This layer is alkaline fine sandy loam to loam. It is slightly saline and slightly to moderately calcareous. The structure is weak subangular blocky or weak prismatic. In some places there are thin lenses of weakly cemented material.
3. The material below 3 to 4 feet is friable, massive, slightly calcareous, very pale brown sandy loam or fine sandy loam.

This soil contains much adsorbed sodium, and it runs together; consequently, permeability is slower than the textures suggest. Included are areas of sandy loam or loam and areas that have more clay in the subsoil.

This soil is deep and well drained. Permeability is moderate, and runoff is slow. The water table is generally 3 to 6 feet below the surface. The water-holding capacity is moderate. The mineral fertility is moderate, except that phosphorus is not in a form readily available to plants. The soil is easy to work and can be leveled at low cost.

This soil is used mainly for range, but an appreciable area is cultivated to irrigated pasture, alfalfa, and field crops. Crop growth is spotty but improves markedly if the soil is reclaimed. Where drainage can be established with ditches or channels, the soil can be leached of excess salts by heavy flooding. Often the surface seals over when wet, and amendments such as gypsum are used to increase permeability. Rice and irrigated pasture can sometimes be grown while the soil is being reclaimed. (Capability unit IIs–6; Storie index rating 54)

Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes (ToA).—This soil has a low water-holding capacity and is slowly permeable. It covers a considerable acreage, but only a few areas are cultivated to cotton and alfalfa. Crops should not be grown until the excess salts have been removed by leaching and by treatment with gypsum or sulfur. The surface seals up tightly when it gets wet; therefore, leaching may be slow and expensive. Saltgrass is the dominant cover, but many areas that are crusted with salts have no vegetation (fig. 15). Diverting streams or excess irrigation water to flood some areas, without leveling, increases measurably the amount of feed produced. (Capability unit IIIs–6; Storie index rating 27)

Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes (TpA).—This soil is difficult to reclaim. If drained, it can be improved by deep leaching and heavy applications of gypsum. It is used for range, except a few small spots that are included with better soils. Salt puffs and barren areas are common. (Capability unit IVs–6; Storie index rating 9)

Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes (ThA).—This soil lies chiefly along the western part of Duck Slough and Dutchman Creek. It is finer textured than the typical soils of the Traver series, probably because of a slight amount of basic igneous sediment in its parent material. The subsoil is slowly permeable.

These areas are used almost entirely for range. Forage yields are fair without irrigation. Some areas are periodically flooded to increase the yield of forage. This soil is more difficult to reclaim than Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes. Where rice or irrigated pasture can be grown, they could be used to leach the soil more quickly and cheaply. (Capability unit IIIs–6; Storie index rating 46)

Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes (TkA).—This soil is slowly permeable and difficult to work. It is used almost entirely for range. Some areas are flooded occasionally. Barren areas are fairly common. (Capability unit IVs–6; Storie index rating 23)

Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes (TmA).—This soil is very slowly permeable. It contains so much salt and alkali that reclamation is slow and costly. It is used only for range. It provides a limited amount of forage. Salt puffs and bare spots occupy a large proportion of the area. (Capability unit IVs–6; Storie index rating 8)

Tujunga Series

The Tujunga soils occur in narrow channels running from the Chowchilla River toward El Nido and in streaks adjacent to the Merced River. These soils are made up of recent, granitic, alluvial sands and gravelly sands. They contain very little silt and clay. The cover is mostly grass, but includes oaks and willows in the moister areas along the Merced River.

These soils are only very slightly weathered. The Tujunga soils are transitional between Riverwash in the present stream channels and the Hanford, Grangeville, Greenfield, and Pachappa soils of the alluvial fans and flood plains. The fan and flood-plain soils contain more silt and clay and are of much higher value for agriculture.

The Tujunga soils consist of very deep deposits of loamy sand, sand, or gravelly sand that are gritty and micaceous and have a pale-brown color similar to that of granite. The sands are neutral or very slightly acid. They become increasingly gravelly or sandy with depth.

Tujunga sand, 0 to 3 percent slopes (TuA).—This soil is most common on the alluvial fans east of El Nido, but some areas lie along the Merced River.

Representative profile:

1. The soil, to a depth of 6 to 8 feet, consists of pale-brown sand that is mainly angular fragments of quartz and feldspar and flakes of mica. It is single grained, loose, and incoherent. It is very low in organic matter. The reaction is neutral or very slightly acid throughout. In many places the soil is stratified. It becomes somewhat gravelly in the lower part.

The texture ranges from washed fine sand to coarse sand and fine gravel about 3 millimeters in diameter. Included are some areas of loamy coarse sand underlain by a slightly finer material.

This soil is excessively drained and very rapidly permeable. It has a very low water-holding capacity. There is no runoff, but there is danger of wind erosion. Mineral fertility is low. The soil is easy to work.

Streaks of this soil that cross fields of finer textured soils often cause trouble with irrigation, because the very rapid percolation of water through the coarse sand makes it difficult to get water to flow through the furrows to the area beyond. If possible, fields should be so arranged that irrigation water need not cross these sandy streaks, and the sandy areas should be irrigated separately. Another solution is to consolidate the water from several furrows and force it across the sandy area in a ditch, possibly one lined with clay or other material.

Areas that are large enough to farm separately should be irrigated with sprinklers, or with large heads, short runs, and frequent light applications. Deep-rooted crops, such as orchard or alfalfa, should be grown. Large amounts of water and fertilizers, including minor elements, are usually required. (Capability unit IVe-4; Storie index rating 38)

Tujunga sand, channeled, 0 to 8 percent slopes (TwA).—This soil occurs along the Merced River. It may be so dissected as to consist entirely of a series of sandy ridges. The texture ranges from fine sand to fine gravel. This soil is similar to Riverwash, but it has a slightly higher moisture-holding capacity. It should be leveled and irrigated only when it is to be cultivated with adjacent more productive soils. The practicality of an expensive leveling operation is questionable. (Capability unit IVe-4; Storie index rating 30)

Tujunga gravelly sand, channeled, 0 to 8 percent slopes (TsA).—This soil is mainly near Snelling and Merced Falls. It is little better than Riverwash, but it is not frequently flooded. It is cultivated where it occurs within fields of other soils. It is poorly suited to crops because of its gravelly texture and its very low moisture-holding capacity. (Capability unit IVe-4; Storie index rating 18)

Tujunga loamy sand, 0 to 3 percent slopes (TtA).—This soil occurs principally on the Chowchilla River alluvial fan, on smooth fans and ridges formed by deposition. Most areas have a cover of ripgut grass. Some wind erosion has occurred. On the lee side of some areas, Delhi sand has accumulated in low, dunelike ridges.

This soil is relatively fertile, except for a general lack of organic matter and nitrogen, which can be easily applied. For some crops there may be a deficiency of zinc and other minor elements. Permeability is very rapid, and the water-holding capacity is low. Where narrow streaks of this soil cross areas of finer textured soils, large amounts of irrigation water may be lost.

This soil is ordinarily farmed in much the same way as Hanford sandy loam. The larger areas are all cultivated. A few narrow streaks that cut through areas of saline-alkali soils are used only for range. (Capability unit IIIe-4; Storie index rating 76)

Waukena Series

The Waukena soils formed in broad, flat, saline-alkali, basin areas where the water table was high and surface runoff was very slow. The parent material was granitic alluvium, slightly mixed with other material. The vegetation consists of saltgrass and other salt-tolerant plants, such as iodinebush.

In the Merced Area, the Waukena soils are associated with the Fresno and Traver soils in some areas and with the Hilmar and Rossi soils in others. The Waukena soils differ from the associated Traver soils in having a slightly leached surface soil, more clay in the subsoil, and stronger structure.

The profile of the Waukena soils consists of a mildly alkaline, slightly hard, light-gray fine sandy loam or loam surface soil that rests abruptly, at a depth of 6 to 10 inches, upon the bleached, rounded caps of a columnar, very hard, strongly alkaline, sandy clay loam subsoil. Below a depth of about 27 inches, the subsoil grades into moderately calcareous sandy clay loam, which grades in turn into stratified fine sandy loam and sandy clay loam below about 40 inches. The concentration of salts may be as high as 1 to 2 percent in the subsoil.

Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes (WaA).—This imperfectly drained to poorly drained soil lies along the fringe of the San Joaquin River flood plain and extends from the Turner Ranch area to the northern edge of the county. It has a mound microrelief. In most places the salts are concentrated in the upper part of the subsoil, but they are at the surface in some spots.

Representative profile:

1. The surface soil, to a depth of 6 to 10 inches, is light-gray fine sandy loam. It has a vesicular surface crust but otherwise is essentially massive. It is leached of lime, except locally, and has a mildly alkaline reaction. The transition to the layer below is abrupt.
2. This layer is light yellowish-brown, very hard sandy clay loam that has strong, columnar structure. The columns are 2 to 4 inches in diameter and have bleached, rounded caps and gray or dark-brown coatings. This layer generally has a strongly alkaline reaction. It has the highest salt content of any layer in the soil. The columns extend to a depth of about 18 inches and grade into moderate, blocky structure that continues to a depth of about 3 feet. This layer is slightly to moderately calcareous and very hard when dry, firm when moist, and sticky when wet.
3. Below a depth of about 3 feet are light-gray, stratified, slightly calcareous, strongly alkaline sediments that contain various amounts of hard lime nodules. The water table is generally within 5 feet of the surface.

Included are areas that have a weaker columnar structure in the subsoil. Some small areas have a lime-silica cemented hardpan like that of the Fresno soils.

The surface soil is moderately permeable. The subsoil is slowly permeable, and roots penetrate only in cracks. Surface runoff is very slow. The erosion hazard is slight. The water-holding capacity is low. The fertility is moderate, but the phosphorus is not readily available to plants. The soil is easy to work.

This soil occurs mainly in an area where the excessive salts have been partly removed by growing rice. The rice returned fair yields, which paid for the cost of leveling, and served as an economical method of reclaiming the soil. The rest of this soil is used only for range. It provides moderate to low amounts of forage. (Capability unit IVs–8; Storie index rating 36)

Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes (WbA).—This soil is slowly permeable. It is low in fertility. (Capability unit IVs–8; Storie index rating 18)

Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes (WcA).—Because of the strong concentration of salts and alkali in this soil, the subsoil is very slowly permeable, and the available water-holding capacity is very low. Many areas are bare of vegetation. (Capability unit VIs–8; Storie index rating 6)

Waukena loam, slightly saline-alkali, 0 to 1 percent slopes (WdA).—This soil occurs chiefly along the San Joaquin River, northwest of Stevinson. The loam surface layer is harder when dry than that of Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes, and it tends to be more calcareous and more alkaline. Range, flooded range, or possibly irrigated pasture or rice are the best uses. Reclamation should not be attempted without careful consideration of the costs and difficulties involved. (Capability unit IVs–8; Storie index rating 36)

Waukena loam, moderately saline-alkali, 0 to 1 percent slopes (WeA).—This soil has a finer textured, harder surface layer than Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes, but it is used in much the same way. (Capability unit IVs–8; Storie index rating 18)

Waukena loam, strongly saline-alkali, 0 to 1 percent slopes (WfA).—This soil has a finer textured, harder surface layer than Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes, but is used in much the same way. (Capability unit VIs–8; Storie index rating 6)

Whiterock Series

The Whiterock soils occur in small areas in the Sierra Nevada foothills along the Mariposa County line. They are shallow soils that formed from sandy slate of the Mariposa formation. The vegetation consists of an association of oaks and annual grass.

These soils typically consist of light yellowish-brown, granular, slightly hard, slightly acid loam about 4 to 16 inches thick, resting abruptly on slate bedrock. Rock outcrops are common.

The Whiterock soils are similar to the Daulton soils, except that slight differences in parent material make the Daulton soils gray.

Whiterock rocky silt loam, 3 to 8 percent slopes (WgB).—This light-colored soil lies on undulating topography along the foothills of the Sierra Nevada. It developed from slate and sandy slate of the Mariposa formation. Outcrops of vertically bedded slate are prominent throughout the area.

Representative profile:

1. The surface soil, to a depth of 4 to 16 inches, is light yellowish-brown to light brownish-gray, slightly acid to medium acid, hard silt loam. It has weak, granular structure when moist, and is platy to massive when dry. This layer is low in organic matter. It contains many platy fragments of slate. The lower boundary is abrupt.
2. This layer is made up of light-gray slate that has distinct, fine, platy cleavage. The surfaces of broken fragments are weathered to a pale brown. The slate is tilted nearly vertically. It outcrops as ledges that run from northwest to southeast. White quartz dikes are common.

This soil is well drained and moderately permeable. Runoff is medium, and the erosion hazard is moderate. The water-holding capacity is very low. The fertility is low.

This soil is too shallow and rocky to cultivate. It is used only for range. (Capability unit VIIe–3; Storie index rating 17)

Whiterock rocky silt loam, 3 to 8 percent slopes, eroded (WgB2).—Erosion has removed part of the surface layer of this soil, and in places gullies have formed. This appears to have been caused by overgrazing and stock trails around watering places. (Capability unit VIIe–3; Storie index rating 14)

Whiterock rocky silt loam, 8 to 30 percent slopes (WgD).—Runoff from this soil is rapid, and the erosion hazard is moderate. Careful rotation of stock and control of grazing are advisable. (Capability unit VIIe–3; Storie index rating 14)

Whiterock rocky silt loam, 8 to 30 percent slopes, eroded (WgD2).—Parts of the surface layer of this soil have been removed by erosion. Some areas are gullied, and the bedrock has been exposed in places. Control of grazing and proper stocking are advisable, in order to maintain the range. (Capability unit VIIe–3; Storie index rating 11)

Whitney Series

The Whitney soils developed on weakly consolidated alluvial sediments that were derived from granitic rocks.

This material has been dissected to rounded, rolling to hilly topography. Where erosion has proceeded rapidly enough, the soil-forming process has been retarded and the Whitney soils have formed. In some areas that have been eroded at varying rates, an intricate pattern of Rocklin and Whitney soils occur. The vegetation consists of a good growth of grass and herbs such as alfileria. Drainage is good.

The Whitney soils have a slightly hard, slightly acid, brown sandy loam to fine sandy loam surface soil that grades at a depth of 1 to 3 feet into weakly consolidated, light yellowish-brown, micaceous sediments. These sediments have a fine laminar bedding in many places but are more coarsely stratified in others. A brownish, light sandy clay loam subsoil lies above the parent material, but it is weakly developed in most places.

Whitney fine sandy loam, 3 to 8 percent slopes (WhB).—This soil occurs mainly on undulating relief in the northern part of the Area. Associated with this soil and merging with it are Rocklin soils and Montpellier coarse sandy loam. In places this soil resembles the Pentz soils.

Representative profile:

1. The surface soil, to a depth of 10 to 20 inches, is brown fine sandy loam that is slightly hard and has weak, granular structure when moist. It is generally massive when dry. The reaction is slightly acid. Organic-matter content is moderately low.
2. The subsoil is brown to strong-brown, light sandy clay loam or heavy fine sandy loam that is slightly harder than the surface soil but is friable when moist. It has massive to very weak, blocky structure. The reaction is neutral to slightly acid. This layer is 4 to 20 inches thick and grades irregularly into the material below.
3. This layer is made up of generally light yellowish-brown or light-gray, weakly consolidated, micaceous strata of fine sand, sand, and silt that contain very little coarse material. It is somewhat mottled with yellow in the upper part.

The color ranges from light reddish brown and light grayish brown to dark brown. In a few places there is a little lime in the upper part of the parent material. The depth ranges up to 4 feet. In places the subsoil is quite distinct. Included are areas of loam. Near the foothills, some gravel may be present in the profile.

This soil is well drained and moderately permeable. It has a moderate water-holding capacity. Runoff is slow, and the erosion hazard is slight. The soil is moderately fertile and easy to work.

This soil is excellent for dryfarmed grain and is used extensively for this purpose. Erosion is not a serious problem, but some control measures should be taken. The common rotation of grain alternated with a year of cultivated fallow exposes the soil to erosion much of the time and should be modified. In other counties, where this soil can be irrigated, orchard crops, including citrus fruits, have been grown in the more nearly frost-free areas. In the Merced Area, however, irrigation water is not available for this soil. (Capability unit IIIe–1; Storie index rating 57)

Whitney fine sandy loam, 3 to 8 percent slopes, eroded (WhB2).—This inextensive soil shows the effects of rilling and sheet erosion. It occurs in spots in grainfields. The surface soil is gone, and the substratum has been plowed up. Erosion control measures, such as contour cultivation, stripcropping, and stubble-mulch farming, should be considered. (Capability unit IIIe–1; Storie index rating 48)

Whitney fine sandy loam, 8 to 15 percent slopes (WhC).—Use and management are much the same for this soil as for Whitney fine sandy loam, 3 to 8 percent slopes. Runoff is medium, and the erosion hazard is moderate. Sheet erosion has thinned the surface layer in places, and erosion control practices are advisable. (Capability unit IVe–1; Storie index rating 50)

Whitney fine sandy loam, 8 to 15 percent slopes, eroded (WhC2).—This soil has shallow gullies, and in some areas the subsoil or substratum has been exposed by plowing. Yields of grain are somewhat less than they were before the soil was eroded. About one-third of the area has been retired from cultivation and is used for range. (Capability unit IVe–1; Storie index rating 38)

Whitney fine sandy loam, 15 to 30 percent slopes, eroded (WhD2).—The substratum of this soil is exposed in spots. Shallow gullies are common. Runoff is rapid, and the hazard of further erosion is severe. The water-holding capacity is low.

About half of this soil is in dryfarmed grain; the rest has reverted to range. Grain yields are fair to low. This soil should be farmed only under a carefully planned program of erosion control. The practice of cultivating the fallow soil during alternate years should be modified, to avoid leaving the soil exposed during the rainy season. (Capability unit VIe–4; Storie index rating 33)

Whitney fine sandy loam, 30 to 45 percent slopes, eroded (WhE2).—Most of this soil is in range. A few fields are still used for grain. Where the soil has been farmed, nearly all of the surface layer has been removed by erosion. The substratum is exposed in places. (Capability unit VIIe–9; Storie index rating 19)

Whitney sandy loam, 3 to 8 percent slopes (WkB).—This soil is coarser textured and more rapidly permeable than Whitney fine sandy loam, 3 to 8 percent slopes. It dries out a little more rapidly, it is lower in organic matter, and it is lighter in color. Generally it is light brown or pale brown. Small areas of Montpellier soils are included.

This soil is used for grain. Use and management are similar to those for Whitney fine sandy loam, 3 to 8 percent slopes. Erosion control practices are probably more needed, however, as the soil appears to have a less stable surface soil and to erode more easily. (Capability unit IIIe–1; Storie index rating 54)

Whitney sandy loam, 8 to 15 percent slopes (WkC).—This soil is used in much the same way as Whitney fine sandy loam, 8 to 15 percent slopes. (Capability unit IVe–1; Storie index rating 48)

Whitney sandy loam, 8 to 15 percent slopes, eroded (WkC2).—This soil is used in the same way as Whitney fine sandy loam, 8 to 15 percent slopes, eroded. (Capability unit IVe–1; Storie index rating 41)

Whitney sandy loam, 15 to 30 percent slopes, eroded (WkD2).—This soil is used in much the same way as Whitney fine sandy loam, 15 to 30 percent slopes, eroded. (Capability unit VIe–4; Storie index rating 31)

Whitney and Rocklin soils, 3 to 8 percent slopes, eroded (WmB2).—These undifferentiated soils occur on undulating topography north and south of the Merced River. The profiles vary according to the rate at which the old terrace materials have been dissected by erosion. Within

short distances the profile ranges from that typical of Rocklin soils, through several intermediate steps, to a profile typical of the Whitney soils. The intermediate profiles resemble those described for the Snelling and Montpellier series, except that they have weakly consolidated sediments in the lower part.

These soils are used almost entirely for dryfarmed grain. The management needed is like that for Rocklin sandy loam, 3 to 8 percent slopes, eroded. (Capability unit IIIe-1; Storie index rating 41)

Whitney and Rocklin soils, 8 to 15 percent slopes, eroded (WmC2).—Use and management for these soils is similar to that for Rocklin sandy loam, 8 to 15 percent slopes, eroded. (Capability unit IVe-1; Storie index rating 31)

Wyman Series

The Wyman soils formed in basic igneous alluvium that had received no fresh material for a considerable time. These soils are very gently sloping to nearly level. They are well drained, except where an unconforming hardpan substratum blocks moisture penetration for part of the year. This hardpan is part of a Yokohl soil buried by the alluvial parent material of the Wyman soil. The cover is annual grass and a few scattered oaks.

These soils have slightly more clay in the subsoil than in the surface layer. The weak, blocky structural aggregates are slightly coated with colloidal matter.

The Wyman soils are younger than the more strongly weathered Ryer soils. Still less weathered alluvium has developed into the Honcut series. Similar soils that developed on other kinds of alluvium are the Greenfield and the Marguerite soils.

Wyman loam, 0 to 3 percent slopes (WrA).—This brown soil is extensive southeast and east of Merced, on very gently sloping alluvial fans and terraces.

Representative profile:

1. The surface soil, to a depth of 12 to 14 inches, consists of brown, nearly neutral loam. It is slightly hard when dry, and friable when moist. It has weak granular to blocky structure when moist, and is essentially massive when dry. It grades into the subsoil below.
2. The subsoil is brown clay loam that grades to silty clay loam. It is hard when dry, and sticky and plastic when wet. It has weak, blocky structure with thin, dark-brown, colloidal coatings on the blocks. This layer is mildly alkaline, and in a few places it is slightly calcareous in the lower part. It grades into the parent material at a depth of 3½ to 4 feet.
3. The parent material consists of stratified, light-brown clay loam, silt loam, and, in a few places, sand. In some places it is mottled and in others it contains a little lime.

Included are areas of silt loam or very fine sandy loam and a few small areas of fine sandy loam. Also included are small areas where the soil is imperfectly drained and faintly mottled and calcareous in the lower part.

This soil is well drained and moderately permeable. It has a high water-holding capacity. Runoff is slow, and there is no erosion hazard. The soil is easy to work, but if worked when too wet it tends to puddle and form a dense, slowly permeable plowsole.

This soil is used extensively for fruits, nuts, alfalfa, irrigated pasture, vegetables, and field crops.

Crops respond well to nitrogen and phosphorus, if both are applied, but do not respond so well to either element applied alone. (Capability unit I-1; Storie index rating 95)

Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes (WtA).—This soil occurs chiefly on the terraces along Dry Creek north of Snelling. At a depth of 24 to 40 inches it is underlain by a bed of rapidly permeable, gravelly material. The water-holding capacity is moderate.

This soil is used chiefly for dryfarmed grain and range. It could be irrigated and farmed more intensively if a water supply could be developed. Yields might be somewhat lower than for the deeper Wyman soils. (Capability unit IIs-3; Storie index rating 85)

Wyman loam, deep over hardpan, 0 to 3 percent slopes (WsA).—This soil is underlain at a depth of 48 to 60 inches by a hardpan, like that in the Yokohl soils. It is similar to Honcut silt loam, deep over hardpan, 0 to 1 percent slopes, except that it has a weakly developed clay loam subsoil. In many places lime is present in the layer between the subsoil and the hardpan.

This soil is used extensively for fruit and truck crops. It has about the same management problems as Honcut silt loam, deep over hardpan, 0 to 1 percent slopes. Yields are somewhat limited by deficiencies of nitrogen and phosphorus, but these elements can be easily supplied. (Capability unit IIs-3; Storie index rating 85)

Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes (WpA).—This soil occurs where a 3- to 4-foot layer of recent alluvium from Bear and Mariposa Creeks has been laid down over saline-alkali basin soils, generally of the Lewis series.

Salt- and alkali-tolerant crops can be grown on this soil. Better yields could be obtained if the salts were leached out. A drainage system should be installed before leaching, to correct the high water table that may result. Gypsum or sulfur should improve the soil. (Capability unit IIs-3; Storie index rating 59)

Wyman clay loam, 0 to 3 percent slopes (WoA).—The surface layer of this soil is finer textured than that of Wyman loam, 0 to 3 percent slopes. It puddles very easily and forms a dense plowsole if worked when too wet. The soil is slightly deficient in nitrogen and phosphorus. Crops should respond to fertilizers that contain these elements. Included with this soil are areas of silty clay loam. (Capability unit I-1; Storie index rating 81)

Wyman clay loam, deep over hardpan, 0 to 1 percent slopes (WnA).—The fine-textured surface layer of this soil puddles readily and forms a plowsole if worked when too wet. The soil is slightly deficient in nitrogen and phosphorus. (Capability unit IIs-3; Storie index rating 72)

Yokohl Series

The Yokohl soils occur near Merced, Planada, and Le Grand and along Dry Creek in the northern part of the Area. They developed on nearly level to gently sloping terraces and alluvial fans from deposits derived mainly from basic igneous rocks. The soils are well drained, but they have a claypan as well as a strongly cemented iron-silica hardpan subsoil, which inhibit the penetration of water into the deeper layers. The vegetation consists of annual grasses, small herbs, and a few oaks.

The Yokohl soils are older and more strongly developed than the associated Honcut, Wyman, and Ryer soils. The profile of the Yokohl soils resembles that of the San Joaquin soils, but the San Joaquin soils developed from granitic material and are generally coarser and more gritty.

The surface soil generally consists of reddish-brown, hard, neutral loam or clay loam. It has weak blocky structure when moist, but is essentially massive when dry. It puddles badly if worked when too wet. This layer has an abrupt boundary over reddish-brown clay that has strong blocky or prismatic structure. It is very hard when dry, and very sticky and plastic when wet. This layer generally rests directly upon a yellowish-red to reddish-brown hardpan, strongly cemented by iron and silica. Lime seams occur in the hardpan and below. Beneath the hardpan, the material gradually gives way to hard, pale-brown, gravelly loam alluvium that is moderately calcareous in the upper part and mottled in the lower part. The claypan is at a constant depth below the surface, but the depth to the hardpan varies considerably. Where the claypan does not rest directly on the hardpan, the material between them is light reddish-brown, faintly mottled, neutral clay loam.

Yokohl loam, 0 to 3 percent slopes (YcA).—This reddish-brown soil lies on very gently sloping old fans and terraces, mainly near Merced and Planada. Undisturbed areas have a mound microrelief.

Representative profile:

1. The surface soil, to a depth of 8 to 12 inches, is reddish-brown, hard, neutral loam. It has weak, blocky structure when moist, and is essentially massive when dry. It becomes more clayey with increasing depth. The lower boundary is abrupt.
2. This layer is reddish-brown, neutral to mildly alkaline clay that has strong, blocky and prismatic structure. It is very hard when dry and very sticky when wet. In a few places, it is mottled in color. This layer, about 6 to 12 inches thick, has an abrupt lower boundary.
3. The reddish-brown to yellowish-red hardpan is strongly cemented and distinctly platy in the upper part; it becomes less cemented and softer in the lower part. Lime is present in seams and blotches, and it increases somewhat with increasing depth.
4. The parent material is generally pale-brown, moderately alkaline, alluvial sediments of hard, gravelly loam. The upper part contains segregated lime.

In some areas the texture is silt loam. In a few areas the soil has a browner color and somewhat resembles Madera loam. In places, the clay subsoil does not rest directly upon the hardpan, but is separated from it by a light reddish-brown layer of clay loam up to about 6 inches in thickness.

This soil is well drained. The surface soil is moderately permeable; the claypan is very slowly permeable; the hardpan is virtually impermeable. Surface runoff is slow, and there is no erosion hazard. The soil is easy to work, but it puddles easily and forms a dense plowsole if worked when too moist.

This soil is used for figs, irrigated pasture, alfalfa, almonds, and other crops. Yields are limited by depth and by pronounced deficiencies of nitrogen and phosphorus. Deep-rooted crops are not well suited to this soil, but they are widely grown because the soil is associated with the deeper Wyman and Honcut soils. Irrigated pasture, field crops, and figs are probably best suited. (Capability unit IVs–3; Storie index rating 32)

Yokohl loam, 3 to 8 percent slopes (YcB).—This soil occurs near Planada. It is used mainly for range, grain, and irrigated pasture. It is similar to Yokohl loam, 0 to 3 percent slopes, but, because of the steeper slopes, it has slightly more rapid runoff and is more difficult to irrigate. (Capability unit IVe–3; Storie index rating 30)

Yokohl clay loam, 0 to 3 percent slopes (YbA).—This soil is similar to Yokohl loam, 0 to 3 percent slopes, except that it has a finer textured, more slowly permeable surface layer and a thicker claypan. In places the claypan is 16 inches in thickness. The two soils are used in the same way and have nearly the same limitations and management problems. If this soil is worked when too wet, however, puddling is more severe, and large clods are formed. Grain, field crops, irrigated pasture, and figs are the best suited crops. (Capability unit IVs–3; Storie index rating 29)

Yokohl clay, 0 to 3 percent slopes (YaA).—In some places this soil may have resulted from the removal of the surface layer of Yokohl loam, 0 to 3 percent slopes, by leveling. It has the same use and management problems and, in addition, the surface layer is slowly permeable and difficult to work. Deep-rooted crops should be avoided. High yields cannot be expected unless large amounts of organic matter, nitrogen, and phosphate are added. (Capability unit IVe–5; Storie index rating 20)

Yolo Series

The Yolo soils are very deep and slightly stratified. They formed from alluvium on flood plains and small alluvial fans of minor streams that drain the low foothills. The material came mainly from metasedimentary rocks of the Mariposa formation. The soils are well drained and have a good cover of annual grass and herbs and many large oaks. The Yolo soils show little or no change in profiles with increasing depth. They are associated with the Marguerite and Burchell soils, which are derived from similar but older materials and have more strongly expressed profiles. The Madera soils are also related to the Yolo soils, but they contain a hardpan subsoil. The Yolo soils are similar to the Honcut soils except for the grayer color and different parent alluvium.

These soils consist of very deep, slightly hard, grayish-brown, relatively uniform but slightly stratified loam. They are weakly granular when moist, but essentially massive when dry. They are highly fertile and readily penetrated by roots and water. The reaction is slightly acid to neutral. In places there is a little lime in the subsoil. Sometimes an unrelated hardpan like that of the Madera soils lies at a depth of 4 to 6 feet, where it prevents water penetration and causes faint mottling in the lower part of the soil.

Yolo loam, 0 to 1 percent slopes (YdA).—This soil occurs mainly along Owens, Deadman, and Dutchman Creeks near Le Grand and Planada. It is composed of grayish-brown alluvium that contains considerable very fine sand locally derived from sandy slate. This soil is granular and friable when moist, and massive and slightly hard when dry. It is neutral to slightly acid, but the subsoil is mildly alkaline in places.

This soil is well drained and moderately permeable. It has a high water-holding capacity. It is very deep and highly fertile. Runoff is slow. There is little erosion

hazard except along stream banks. The soil is easy to work.

This is an excellent soil for intensive irrigated agriculture. In use and management it is like Honcut fine sandy loam, 0 to 1 percent slopes, or Honcut silt loam, 0 to 1 percent slopes. (Capability unit I-1; Storie index rating 100)

Yolo loam, deep over hardpan, 0 to 1 percent slopes (YeA).—This soil is similar to Yolo loam, 0 to 1 percent slopes, but it is underlain by older hardpan soils, chiefly of the Madera series. The profile is grayish brown because of the dark color of the sandy slate from which the parent material was derived. Except for slight differences in texture and parent material, this soil is similar to Honcut silt loam, deep over hardpan, 0 to 1 percent slopes, and it is similar in use and management. (Capability unit IIs-3; Storie index rating 80)

Use and Management

The aim of good land use is to produce a good income over a period of years and at the same time keep up the productivity of the soil. To achieve this requires using the land in a way to which it is well suited, growing crops that are well suited to each soil, and using methods of management—including irrigation, crop rotation, tillage, and fertilization—that will maintain or build up the fertility of the soil and control erosion.

The first part of this section shows the suitability of each soil in the Merced Area for general agriculture and for specific crops that are commonly grown. The second part groups the soils according to their capability for agriculture and gives some suggestions for the management of the soils in each group.

Relative Suitability for Agriculture

In table 6 the soils of the Area are rated according to the Storie index, which is a numerical expression of the estimated value of a soil for general intensive agriculture. The rating is based on soil characteristics and qualities and is obtained by evaluating such factors as effective rooting depth, texture of the surface soil, density of the subsoil, drainage, salt and alkali content, and slope. Climate, availability of water for irrigation, distance from markets, and other factors that might determine the desirability of growing certain plants in a given locality are not considered. In itself, therefore, the index cannot be considered as an index of land evaluation, but it is useful in comparing different soils.

Four general factors are considered in the index rating. These factors are (A) the characteristics of the soil profile and the effective rooting depth; (B) the texture of the surface soil; (C) slope; and (X) other factors, such as drainage, salts, alkali, and erosion. Each of these four factors is evaluated on the basis of 100 percent. A rating of 100 percent expresses the most favorable, or ideal, condition. Lower percentage ratings are given if conditions are less favorable for crop production.

TABLE 6.—*Storie index rating for the soils of the Merced Area, Calif.*

Mapping unit	Index rating factors				Index rating	Subgrade
	A	B	C	X		
Alamo clay, 0 to 1 percent slopes	30	60	100	[1] 64	12	5A
Amador loam, 0 to 8 percent slopes	30	95	90	[2] 34	9	6B
Amador loam, 8 to 30 percent slopes	30	95	75	[2] 34	7	6B
Amador loam, 30 to 45 percent slopes	20	95	40	[3] 56	4	6B
Anderson gravelly soils, channeled, 0 to 3 percent slopes	80	50	95	[4] 45	17	5B
Atwater sand, 0 to 3 percent slopes	95	70	95	[5] 80	50	3A
Atwater sand, 3 to 8 percent slopes	95	70	90	[5] 80	47	3A
Atwater loamy sand, 0 to 3 percent slopes	95	90	95	[5] 90	73	2A
Atwater loamy sand, 3 to 8 percent slopes	95	90	90	90	69	2A
Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes	95	90	95	[6] 80	65	2A
Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes	70	90	95	[5] 90	54	3A
Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes	70	90	95	[6] 80	48	3A
Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes	70	90	90	[5] 90	51	3A
Auburn rocky silt loam, 3 to 8 percent slopes	40	60	90	[7] 90	23	4D
Bear Creek loam, 0 to 3 percent slopes	70	100	100	[1] 76	53	3B
Bear Creek clay loam, 0 to 3 percent slopes	70	85	100	[1] 76	45	3B
Bear Creek soils, 0 to 3 percent slopes	50	85	100	[1] 76	23	4D
Borden fine sandy loam, 0 to 3 percent slopes	80	100	100	100	80	1B
Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	80	100	100	[8] 56	45	3B
Burchell silt loam, 0 to 1 percent slopes	95	100	100	[6] 70	67	2B
Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes	95	100	100	[8] 49	47	3B
Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes	95	100	100	[8] 21	20	4B
Burchell silty clay loam, 0 to 1 percent slopes	95	90	100	[6] 70	60	2B
Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	95	90	100	[8] 49	42	3B
Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	95	90	100	[8] 21	18	5A
Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes	80	100	100	100	80	1B
Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes	80	100	100	100	80	1B
Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes	75	100	100	100	75	2B
Columbia soils, channeled, 0 to 3 percent slopes	100	70	100	[4] 50	35	4A
Corning gravelly sandy loam, 0 to 8 percent slopes	70	50	90	[9] 56	18	5B

See footnotes at end of table.

TABLE 6.—*Storie index rating for the soils of the Merced Area, Calif.*—Continued

Mapping unit	Index rating factors				Index rating	Subgrade
	A	B	C	X		
Corning gravelly sandy loam, 8 to 30 percent slopes	70	50	75	[9] 56	15	5B
Corning gravelly sandy loam, 8 to 30 percent slopes, eroded	70	50	75	[10] 39	11	5B
Corning gravelly sandy loam, 30 to 45 percent slopes, eroded	70	50	40	[11] 56	8	6B
Corning gravelly loam, 0 to 8 percent slopes	70	65	90	[9] 56	23	4D
Corning gravelly loam, 8 to 30 percent slopes	70	65	70	[9] 56	19	5B
Corning gravelly loam, 8 to 30 percent slopes, eroded	70	65	70	[10] 39	13	5B
Corning gravelly loam, 30 to 45 percent slopes, eroded	70	65	40	[7] 80	14	5B
Corning cobbly loam, 3 to 8 percent slopes	70	50	90	[9] 56	18	5B
Corning cobbly loam, 8 to 30 percent slopes	70	50	75	[9] 56	15	5B
Daulton rocky silt loam, 3 to 8 percent slopes	20	70	90	[7] 90	10	5B
Daulton rocky silt loam, 8 to 30 percent slopes, eroded	20	70	75	[11] 63	7	6B
Delhi sand, 0 to 3 percent slopes	100	60	95	[5] 80	46	3A
Delhi sand, 3 to 8 percent slopes	100	60	90	[5] 80	43	3A
Delhi sand, 8 to 15 percent slopes	100	60	85	[5] 80	41	3C
Delhi loamy sand, 0 to 3 percent slopes	100	80	95	[5] 90	68	2A
Delhi loamy sand, 3 to 8 percent slopes	100	80	90	[5] 90	65	2A
Delhi loamy fine sand, 0 to 3 percent slopes	100	85	95	[5] 90	73	2A
Delhi loamy fine sand, 3 to 8 percent slopes	100	85	90	[5] 90	69	2A
Delhi sand, silty substratum, 0 to 3 percent slopes	95	70	95	[6] 80	51	3A
Delhi sand, silty substratum, 3 to 8 percent slopes	95	70	90	[5] 80	48	3A
Delhi loamy sand, silty substratum, 0 to 3 percent slopes	95	90	95	[5] 90	73	2A
Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes	95	90	95	[5] 95	77	2A
Dello sand, 0 to 1 percent slopes	100	60	95	[5] 80	46	3A
Dello sand, slightly saline-alkali, 0 to 1 percent slopes	100	60	95	[8] 64	36	4A
Dello sand, poorly drained, 0 to 1 percent slopes	100	60	95	[6] 30	17	5A
Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	100	60	95	[8] 24	14	5A
Dello loamy fine sand, 0 to 1 percent slopes	100	85	95	[6] 80	65	2A
Dinuba sandy loam, 0 to 1 percent slopes	90	95	100	[6] 90	77	2A
Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes	90	95	100	[12] 70	60	2B
Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes	90	95	100	[8] 35	30	4B
Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes	90	95	100	[8] 15	13	5A
Dune land, 0 to 3 percent slopes	100	60	95	[4] 40	23	4A
Dune land, 3 to 8 percent slopes	100	60	90	[4] 30	16	5B
Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes	40	70	75	[7] 90	19	5B
Foster fine sandy loam, 0 to 1 percent slopes	100	100	95	[6] 40	38	4B
Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	100	100	95	[8] 28	26	4B
Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes	100	100	95	[6] 20	19	5A
Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes	100	100	95	[8] 14	13	5A
Foster gravelly fine sandy loam, 0 to 1 percent slopes	100	60	95	[6] 40	23	4D
Fresno loam, slightly saline-alkali, 0 to 1 percent slopes	30	100	100	[13] 70	21	4B
Fresno loam, moderately saline-alkali, 0 to 1 percent slopes	30	100	100	[13] 27	8	6A
Fresno loam, strongly saline-alkali, 0 to 1 percent slopes	30	100	100	[13] 9	3	6A
Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes	30	100	100	[8] 14	4	6A
Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes	30	100	100	[8] 6	2	6A
Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes	30	100	100	[8] 2	1	6A
Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes	30	85	100	[13] 63	16	5A
Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes	30	85	100	[13] 27	7	6A
Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes	30	85	100	[13] 9	2	6A
Grangeville fine sandy loam, 0 to 1 percent slopes	100	100	100	[6] 80	80	1B
Grangeville loam, 0 to 1 percent slopes	100	100	100	[6] 80	80	1B
Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes	100	100	100	[6] 70	70	2B
Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes	100	100	100	[8] 24	24	4B
Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes	70	95	95	[7] 95	67	2B
Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes	70	95	90	[7] 95	57	3D
Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied	70	95	95	[11] 66	42	3D
Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes	70	95	100	[1] 66	44	3B
Hanford sandy loam, 0 to 1 percent slopes	100	95	100	100	95	1A
Hanford gravelly sandy loam, 0 to 1 percent slopes	100	70	100	100	70	2A
Hanford fine sandy loam, 0 to 1 percent slopes	100	100	100	100	100	1A
Hanford fine sandy loam, channeled, 0 to 8 percent slopes	100	100	70	100	70	2C
Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes	75	100	100	100	75	2A
Hilmar loamy sand, 0 to 3 percent slopes	90	90	95	[5] 90	69	2A

See footnotes at end of table.

TABLE 6.—*Storie index rating for the soils of the Merced Area, Calif.*—Continued

Mapping unit	Index rating factors				Index rating	Subgrade
	A	B	C	X		
Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes	90	90	95	[14] 63	48	3B
Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	90	90	100	[8] 35	28	4A
Hilmar sand, 0 to 3 percent slopes	90	70	95	[15] 72	43	3A
Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes	90	70	95	[14] 56	33	4A
Hilmar sand, poorly drained, 0 to 1 percent slopes	90	70	100	[6] 50	32	4A
Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes	90	70	100	[8] 15	10	5A
Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes	90	70	100	[8] 5	3	6A
Honcut silt loam, 0 to 1 percent slopes	100	100	100	100	100	1A
Honcut silt loam, deep over hardpan, 0 to 1 percent slopes	80	100	100	100	80	1B
Honcut fine sandy loam, 0 to 1 percent slopes	100	100	100	100	100	1A
Honcut gravelly sandy loam, 0 to 1 percent slopes	100	70	100	100	70	2A
Honcut silty clay loam, 0 to 1 percent slopes	100	90	100	100	90	1A
Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes	80	90	100	100	72	2B
Honcut silty clay loam, channeled, 0 to 8 percent slopes	80	90	90	100	65	2C
Hopeton clay loam, 0 to 3 percent slopes	70	85	100	[7] 80	48	3D
Hopeton clay loam, 3 to 8 percent slopes	70	85	95	[7] 80	45	3D
Hopeton clay loam, 8 to 15 percent slopes	70	85	80	[7] 80	38	4C
Hopeton gravelly clay loam, 0 to 8 percent slopes	70	70	95	[7] 80	38	4D
Hopeton clay, 0 to 8 percent slopes	70	50	90	[7] 80	25	4D
Hornitos fine sandy loam, 3 to 8 percent slopes	30	100	90	[2] 41	11	5B
Hornitos fine sandy loam, 8 to 30 percent slopes	30	100	75	[2] 41	9	6B
Hornitos fine sandy loam, 30 to 45 percent slopes	30	100	40	[3] 64	8	6B
Hornitos gravelly fine sandy loam, 0 to 8 percent slopes	30	70	90	[2] 41	8	6B
Hornitos gravelly fine sandy loam, 8 to 30 percent slopes	30	70	75	[2] 41	6	6B
Keyes gravelly loam, 0 to 8 percent slopes	25	70	90	[9] 56	9	6B
Keyes gravelly loam, 8 to 15 percent slopes	25	70	80	[9] 56	8	6B
Keyes gravelly clay loam, 0 to 8 percent slopes	25	70	90	[9] 56	9	6B
Keyes-Pentz gravelly loams, 0 to 8 percent slopes	25	70	90	[9] 56	9	6B
Landlow silty clay loam, 0 to 1 percent slopes	60	90	100	[6] 80	43	3B
Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	60	90	100	[8] 56	30	4B
Landlow silt loam, 0 to 1 percent slopes	60	100	100	[6] 80	48	3B
Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes	60	100	100	[8] 56	34	4B
Landlow clay, 0 to 1 percent slopes	60	60	100	[6] 80	29	4B
Landlow clay, slightly saline-alkali, 0 to 1 percent slopes	60	60	100	[8] 56	20	4B
Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	40	100	100	[13] 63	25	4B
Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	40	100	100	[13] 27	11	5A
Lewis loam, strongly saline-alkali, 0 to 1 percent slopes	40	100	100	[13] 9	4	6A
Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	40	90	100	[13] 63	23	4B
Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	40	90	100	[13] 27	10	5A
Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes	40	90	100	[13] 9	3	6A
Lewis clay, slightly saline-alkali, 0 to 1 percent slopes	40	60	100	[13] 63	15	5A
Lewis clay, moderately saline-alkali, 0 to 1 percent slopes	40	60	100	[13] 27	6	6A
Madera sandy loam, 0 to 3 percent slopes	35	95	95	[7] 90	28	4D
Madera sandy loam, 3 to 8 percent slopes	35	95	90	[7] 90	27	4D
Madera fine sandy loam, 0 to 3 percent slopes	35	100	95	[7] 90	30	4D
Madera loam, 0 to 1 percent slopes	35	100	100	[7] 90	31	4D
Madera loam, slightly saline-alkali, 0 to 1 percent slopes	35	100	100	[12] 70	25	4B
Marguerite loam, 0 to 1 percent slopes	95	100	100	100	95	1A
Marguerite silty clay loam, 0 to 1 percent slopes	95	90	100	100	85	1A
Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes	85	90	100	100	76	2B
Merced clay loam, slightly saline, 0 to 1 percent slopes	70	85	100	[12] 90	54	3B
Merced clay loam, moderately saline, 0 to 1 percent slopes	70	85	100	[12] 50	30	4B
Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes	70	90	100	[12] 90	57	3B
Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes	70	85	100	[13] 10	6	6A
Merced clay, slightly saline, 0 to 1 percent slopes	70	60	100	[12] 90	38	4B
Merced clay, moderately saline, 0 to 1 percent slopes	70	60	100	[12] 50	21	4B
Montpellier coarse sandy loam, 0 to 3 percent slopes	70	90	95	[7] 85	51	3D
Montpellier coarse sandy loam, 3 to 8 percent slopes	70	90	90	[7] 85	48	3C
Montpellier coarse sandy loam, 8 to 15 percent slopes	70	90	80	[7] 85	43	3C
Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded	70	90	80	[11] 68	34	4C
Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded	70	90	70	[11] 68	30	4C
Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded	70	90	40	[11] 76	19	5B
Pachappa sandy loam, 0 to 1 percent slopes	95	95	100	100	90	1A
Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	95	95	100	[12] 70	63	2B
Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes	70	95	100	100	67	2B
Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	70	95	100	[12] 70	47	3B
Pachappa fine sandy loam, 0 to 1 percent slopes	95	100	100	100	95	1A
Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	95	100	100	[12] 70	67	2B

See footnotes at end of table.

TABLE 6.—*Storie index rating for the soils of the Merced Area, Calif.*—Continued

Mapping unit	Index rating factors				Index rating	Subgrade
	A	B	C	X		
Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes	75	100	100	100	75	2B
Pentz loam, 0 to 8 percent slopes	30	100	90	[9] 81	22	4D
Pentz loam, 8 to 30 percent slopes	30	100	70	[7] 90	19	5B
Pentz loam, 30 to 75 percent slopes	30	100	30	[7] 90	8	6B
Pentz gravelly loam, 0 to 8 percent slopes	30	70	90	[9] 81	15	5B
Pentz gravelly loam, 8 to 30 percent slopes	30	70	75	[7] 90	14	5B
Pentz clay loam, 0 to 8 percent slopes	30	85	90	[7] 90	21	4D
Pentz clay loam, 8 to 30 percent slopes	30	85	75	[7] 90	17	5B
Peters clay, 0 to 8 percent slopes	40	60	90	[7] 90	19	5B
Peters clay, 8 to 15 percent slopes	40	60	85	[7] 90	18	5B
Peters cobbly clay, 0 to 8 percent slopes	40	50	90	[7] 90	16	5B
Peters cobbly clay, 8 to 30 percent slopes	40	50	75	[7] 90	14	5B
Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	95	95	95	[12] 90	77	2B
Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes	95	95	95	[12] 50	43	3B
Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	95	95	95	[12] 15	13	5A
Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes	95	95	95	[13] 9	8	6A
Pits					[16] <5	6B
Porterville clay, 0 to 3 percent slopes	80	60	100	[7] 95	46	3D
Porterville clay, 3 to 8 percent slopes	80	60	95	[7] 95	43	3D
Pozo clay loam, 0 to 1 percent slopes	40	85	100	100	34	4B
Pozo clay loam, slightly saline, 0 to 1 percent slopes	40	85	100	[12] 90	30	4B
Pozo clay loam, moderately saline, 0 to 1 percent slopes	40	85	100	[12] 50	17	5A
Raynor clay, 0 to 3 percent slopes	70	60	100	[7] 90	38	4D
Raynor clay, 3 to 8 percent slopes	70	60	95	[7] 90	36	4D
Raynor clay, 8 to 15 percent slopes	70	60	90	[7] 90	34	4C
Raynor cobbly clay, 0 to 3 percent slopes	70	50	100	[7] 90	32	4D
Raynor cobbly clay, 3 to 8 percent slopes	70	50	95	[7] 90	30	4D
Raynor cobbly clay, 8 to 15 percent slopes	70	50	90	[7] 90	28	4C
Redding gravelly loam, 0 to 8 percent slopes	25	70	90	[7] 70	11	5B
Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes	25	70	95	[1] 35	3	6B
Redding gravelly loam, 8 to 30 percent slopes	25	70	75	[7] 70	9	6B
Redding cobbly loam, 0 to 8 percent slopes	25	60	90	[7] 70	9	6B
Riverwash					[16] <5	6B
Rocklin loam, 0 to 3 percent slopes	50	100	95	[7] 90	43	3D
Rocklin loam, 3 to 8 percent slopes	50	100	90	[7] 90	41	3D
Rocklin loam, 8 to 15 percent slopes	50	100	80	[7] 90	26	4C
Rocklin sandy loam, 0 to 3 percent slopes	50	95	95	[7] 90	41	3D
Rocklin sandy loam, 3 to 8 percent slopes	50	95	90	[7] 90	38	4D
Rocklin sandy loam, 3 to 8 percent slopes, eroded	50	95	90	[11] 72	30	4D
Rocklin sandy loam, 8 to 15 percent slopes, eroded	50	95	80	[11] 72	26	4C
Rossi clay, moderately saline-alkali, 0 to 1 percent slopes	60	60	100	[12] 30	11	5A
Rossi clay, strongly saline-alkali, 0 to 1 percent slopes	60	60	100	[12] 10	4	6A
Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	60	85	100	[12] 70	36	4B
Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes	60	85	100	[12] 30	15	5A
Rossi clay loam, strongly saline-alkali, 0 tol percent slopes	60	86	100	[12] 10	5	6A
Ryer silt loam, 0 to 3 percent slopes	85	100	100	100	85	1B
Ryer clay loam, 0 to 3 percent slopes	90	85	100	100	77	2B
Ryer clay loam, 3 to 8 percent slopes	90	85	90	100	69	2C
Sandstone rock land					[16] <5	6B
San Joaquin sandy loam, 0 to 3 percent slopes	30	95	95	[7] 90	24	4D
San Joaquin sandy loam, 3 to 8 percent slopes	30	95	90	[7] 90	22	4D
San Joaquin loam, 0 to 3 percent slopes	30	100	95	[7] 90	25	4D
San Joaquin loam, 3 to 8 percent slopes	30	100	90	[7] 90	24	4D
San Joaquin-Alamo complex, 0 to 3 percent slopes	30	70	95	100	20	4D
Schist rock land					[16] <5	6B
Sesame rocky loam, 3 to 8 percent slopes	40	90	90	[7] 90	29	4D
Sesame rocky loam, 8 to 30 percent slopes	40	90	75	[7] 90	24	4C
Seville clay, 0 to 3 percent slopes	40	60	100	100	24	4D
Seville clay, 3 to 8 percent slopes	40	60	95	100	23	4D
Slate rock land					[16] <5	6B
Slickens					[16] 80	1A
Snelling sandy loam, 0 to 3 percent slopes	90	95	100	100	85	1B
Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes	90	95	100	[6] 65	56	3B
Snelling sandy loam, 3 to 8 percent slopes	90	95	90	100	77	2C
Snelling sandy loam, 3 to 8 percent slopes, eroded	90	95	90	[17] 80	62	2C
Snelling sandy loam, 8 to 15 percent slopes	90	95	80	100	68	2C
Snelling sandy loam, 8 to 15 percent slopes, eroded	90	95	80	[17] 80	55	3C
Snelling sandy loam, 15 to 30 percent slopes, eroded	90	95	70	[17] 70	42	3C
Tailings					[10] 0	6B
Temple loam, 0 to 1 percent slopes	95	100	100	[6] 80	76	2B

See footnotes at end of table.

TABLE 6.—*Storie index rating for the soils of the Merced Area, Calif.*—Continued

Mapping unit	Index rating factors A	B	C	X	Index rating	Subgrade
Temple loam, slightly saline, 0 to 1 percent slopes	95	100	100	[8] 76	73	2B
Temple clay loam, 0 to 1 percent slopes	95	85	100	[6] 85	69	2B
Temple clay loam, slightly saline, 0 to 1 percent slopes	95	85	100	[8] 76	62	2B
Temple clay loam, slightly saline, channeled, 0 to 3 percent slope	95	85	100	[13] 63	51	3B
Terrace escarpments	85	90	20	[17] 30	5	6B
Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	90	100	100	[12] 60	54	3B
Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	90	100	100	[12] 30	27	4B
Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	90	100	100	[12] 10	9	6A
Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes	90	85	100	[12] 60	46	3B
Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes	90	85	100	[12] 30	23	4B
Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes	90	85	100	[12] 10	8	6A
Tuff rock land	---	---	---	---	[16] <5	6B
Tujunga sand, 0 to 3 percent slopes	85	50	100	[6] 90	38	4A
Tujunga sand, channeled, 0 to 8 percent slopes	85	50	100	[4] 70	30	4A
Tujunga gravelly sand, channeled, 0 to 8 percent slopes	85	30	100	[4] 70	18	5B
Tujunga loamy sand, 0 to 3 percent slopes	100	80	100	[5] 95	76	2A
Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	60	100	100	[12] 60	36	4B
Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	60	100	100	[12] 30	18	5A
Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	60	100	100	[12] 10	6	6A
Waukena loam, slightly saline-alkali, 0 to 1 percent slopes	60	100	100	[12] 60	36	4B
Waukena loam, moderately saline-alkali, 0 to 1 percent slopes	60	100	100	[12] 30	18	5A
Waukena loam, strongly saline-alkali, 0 to 1 percent slopes	60	100	100	[12] 10	6	6A
Whiterock rocky silt loam, 3 to 8 percent slopes	30	70	90	[7] 90	17	5B
Whiterock rocky silt loam, 3 to 8 percent slopes, eroded	30	70	90	[11] 72	14	5B
Whiterock rocky silt loam, 8 to 30 percent slopes	30	70	75	[7] 90	14	5B
Whiterock rocky silt loam, 8 to 30 percent slopes, eroded	30	70	75	[11] 72	11	5B
Whitney fine sandy loam, 3 to 8 percent slopes	70	100	90	[7] 90	57	3C
Whitney fine sandy loam, 3 to 8 percent slopes, eroded	70	100	90	[11] 76	48	3C
Whitney fine sandy loam, 8 to 15 percent slopes	70	100	80	[7] 90	50	3C
Whitney fine sandy loam, 8 to 15 percent slopes, eroded	70	100	80	[11] 68	38	4C
Whitney fine sandy loam, 15 to 30 percent slopes, eroded	70	100	70	[11] 68	33	4C
Whitney fine sandy loam, 30 to 45 percent slopes, eroded	70	100	40	[11] 68	19	5B
Whitney sandy loam, 3 to 8 percent slopes	70	95	90	[7] 90	54	3C
Whitney sandy loam, 8 to 15 percent slopes	70	95	80	[7] 90	48	3C
Whitney sandy loam, 8 to 15 percent slopes, eroded	70	95	80	[11] 76	41	3C
Whitney sandy loam, 15 to 30 percent slopes, eroded	70	95	70	[11] 68	31	4C
Whitney and Rocklin soils, 3 to 8 percent slopes, eroded	---	---	---	---	[16] 41	3C
Whitney and Rocklin soils, 8 to 15 percent slopes, eroded	---	---	---	---	[16] 31	4C
Wyman loam, 0 to 3 percent slopes	95	100	100	100	95	1A
Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes	85	100	100	100	85	1A
Wyman loam, deep over hardpan, 0 to 3 percent slopes	85	100	100	100	85	1B
Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	85	100	100	[12] 70	59	3B
Wyman clay loam, 0 to 3 percent slopes	95	85	100	100	81	1A
Wyman clay loam, deep over hardpan, 0 to 1 percent slopes	85	85	100	100	72	2B
Yokohl loam, 0 to 3 percent slopes	40	100	95	[7] 85	32	4D
Yokohl loam, 3 to 8 percent slopes	40	100	90	[7] 85	30	4D
Yokohl clay loam, 0 to 3 percent slopes	40	85	100	[7] 85	29	4D
Yokohl clay, 0 to 3 percent slopes	40	60	100	[7] 85	20	4D
Yolo loam, 0 to 1 percent slopes	100	100	100	100	100	1A
Yolo loam, deep over hardpan, 0 to 1 percent slopes	80	100	100	100	80	1B

1 Poor drainage and low nutrient level.
2 Low nutrient level, mound microrelief (hogwallows), and strongly acid reaction.
3 Low nutrient level and strongly acid reaction.
4 Mound or channel microrelief.
5 Wind erosion.
6 Poor drainage or high water table.
7 Low nutrient level.
8 Salts and alkali, and abnormally poor drainage.
9 Mound microrelief and low nutrient level.
10 Erosion, mound microrelief, and low nutrient level.
11 Erosion and low nutrient level.
12 Salts and alkali.
13 Salts and alkali, and mound or channel microrelief.
14 Salts and alkali, and wind erosion.
15 Slightly affected by high water table, and wind erosion.
16 Estimated value; not obtained by use factors.
17 Erosion.

The index rating for a soil is obtained by multiplying the four factors, A, B, C, and X; thus, any one factor may dominate in, or control, the final rating. For example, a soil may have an excellent profile justifying a rating of 100 percent for factor A; excellent surface soil conditions justifying a rating of 100 percent for factor B: a smooth, nearly level surface justifying a rating of 100 percent for factor C; but a large accumulation of salts or alkali that would give a rating of 10 percent for factor X. Multiplying these four ratings gives an index rating of 10 for this soil. The accumulation of salts and alkali determines the productivity of the soil for crops and justifies the low index rating of 10.

The soils have been graded according to their suit-

ability for general intensive agriculture as shown by their Storie index ratings. The six grades and their range in index ratings are:

	Index rating
Grade 1	80 to 100.
Grade 2	60 to 80.
Grade 3	40 to 60.
Grade 4	20 to 40.
Grade 5	10 to 20.
Grade 6	Less than 10.

Soils of grade 1 are excellent and well suited to general intensive agriculture. Soils of grade 2 are good and are moderately well suited to agriculture. Soils of grade 3 are only fairly well suited, soils of grade 4 are poorly suited, and soils of grade 5 are very poorly suited to agriculture. The soils and land types in grade 6 are not suited to agriculture.

The soil grades have been subdivided according to the general nature of the limitations that affect the use of the soils. Brief descriptions of the grades and subgrades and a list of the soils in each follow:

Grade 1.—Soils Well Suited to General Intensive Agriculture

These soils are easily worked and irrigated. Productivity is relatively easy to maintain or improve. There are no special problems of excess salts or alkali, drainage, or erosion.

Subgrade 1A.—Soils without significant limitation for the production of most crops commonly grown in the Area.

- Hanford fine sandy loam, 0 to 1 percent slopes.
- Hanford sandy loam, 0 to 1 percent slopes.
- Honcut fine sandy loam, 0 to 1 percent slopes.
- Honcut silt loam, 0 to 1 percent slopes.
- Honcut silty clay loam, 0 to 1 percent slopes.
- Marguerite loam, 0 to 1 percent slopes.
- Marguerite silty clay loam, 0 to 1 percent slopes.
- Pachappa fine sandy loam, 0 to 1 percent slopes.
- Pachappa sandy loam, 0 to 1 percent slopes.
- Slickens.
- Wyman clay loam, 0 to 3 percent slopes.
- Wyman loam, 0 to 3 percent slopes.
- Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes.
- Yolo loam, 0 to 1 percent slopes.

Subgrade 1B.—Soils that are limited only slightly in depth, permeability, or subdrainage; productivity can be increased by careful irrigation and by improvement of drainage.

- Borden fine sandy loam, 0 to 3 percent slopes.
- Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes.
- Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes.
- Grangeville fine sandy loam, 0 to 1 percent slopes.
- Grangeville loam, 0 to 1 percent slopes.
- Honcut silt loam, deep over hardpan, 0 to 1 percent slopes.
- Ryer silt loam, 0 to 3 percent slopes.
- Snelling sandy loam, 0 to 3 percent slopes.
- Wyman loam, deep over hardpan, 0 to 3 percent slopes.
- Yolo loam, deep over hardpan, 0 to 1 percent slopes.

Grade 2.—Soils Moderately Well Suited to General Intensive Agriculture

These soils are fairly easy to work and to irrigate. Few special practices are needed for erosion control, salt and alkali reclamation, or drainage. The range of crops and the yields are slightly restricted.

Subgrade 2A.—Relatively coarse textured soils that are limited by rather low moisture-holding capacity and slight to severe hazard of wind erosion.

- Atwater loamy sand, 0 to 3 percent slopes.
- Atwater loamy sand, 3 to 8 percent slopes.
- Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes.
- Delhi loamy fine sand, 0 to 3 percent slopes.
- Delhi loamy fine sand, 3 to 8 percent slopes.
- Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes.
- Delhi loamy sand, 0 to 3 percent slopes.
- Delhi loamy sand, 3 to 8 percent slopes.
- Delhi loamy sand, silty substratum, 0 to 3 percent slopes.
- Dello loamy fine sand, 0 to 1 percent slopes.
- Dinuba sandy loam, 0 to 1 percent slopes.
- Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes.
- Hanford gravelly sandy loam, 0 to 1 percent slopes.
- Hilmar loamy sand, 0 to 3 percent slopes.
- Honcut gravelly sandy loam, 0 to 1 percent slopes.
- Tujunga loamy sand, 0 to 3 percent slopes.

Subgrade 2B.—Imperfectly drained to well drained, moderately coarse textured to moderately fine textured soils that are slightly limited by salts or alkali, impermeable substrata, or a moderately developed subsoil; the productivity of some can be increased by improvement of drainage or by removing salts and alkali.

- Burchell silt loam, 0 to 1 percent slopes.
- Burchell silty clay loam, 0 to 1 percent slopes.
- Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes.
- Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes.
- Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes.
- Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes.
- Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes.
- Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes.
- Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes.
- Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
- Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes.
- Ryer clay loam, 0 to 3 percent slopes.
- Temple clay loam, 0 to 1 percent slopes.
- Temple clay loam, slightly saline, 0 to 1 percent slopes.
- Temple loam, 0 to 1 percent slopes.
- Temple loam, slightly saline, 0 to 1 percent slopes.
- Wyman clay loam, deep over hardpan, 0 to 1 percent slopes.

Subgrade 2C.—Well-drained, undulating soils that have moderately developed subsoils; also deep, permeable soils that are cut by stream channels and are subject to occasional flooding.

- Hanford fine sandy loam, channeled, 0 to 8 percent slopes.
- Honcut silty clay loam, channeled, 0 to 8 percent slopes.
- Ryer clay loam, 3 to 8 percent slopes.
- Snelling sandy loam, 3 to 8 percent slopes.
- Snelling sandy loam, 3 to 8 percent slopes, eroded
- Snelling sandy loam, 8 to 15 percent slopes.

GRADE 3.—SOILS ONLY FAIRLY WELL SUITED TO GENERAL INTENSIVE AGRICULTURE.

The range of crops and the yields are rather restricted. Productivity may be difficult to improve.

Subgrade 3A.—Coarse-textured soils that are limited by low moisture-holding capacity, severe hazard of wind erosion, or poor drainage; restricted for shallow-rooted crops by the droughtiness of the surface soil.

Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes.
Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes.
Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes.
Atwater sand, 0 to 3 percent slopes.
Atwater sand, 3 to 8 percent slopes.
Delhi sand, 0 to 3 percent slopes.
Delhi sand, 3 to 8 percent slopes.
Delhi sand, silty substratum, 0 to 3 percent slopes.
Delhi sand, silty substratum, 3 to 8 percent slopes.
Dello sand, 0 to 1 percent slopes.
Hilmar sand, 0 to 3 percent slopes.

Subgrade 3B.—Imperfectly drained to well-drained soils, also soils that contain slight concentrations of soluble salts or alkali; productivity can generally be increased somewhat by improvement of drainage or by removing salts and alkali; highly restricted for orchards.

Bear Creek clay loam, 0 to 3 percent slopes.
Bear Creek loam, 0 to 3 percent slopes.
Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes.
Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes.
Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes.
Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes.
Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes.
Landlow silt loam, 0 to 1 percent slopes.
Landlow silty clay loam, 0 to 1 percent slopes.
Merced clay loam, slightly saline, 0 to 1 percent slopes.
Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes.
Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.
Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes.
Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes.
Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes.
Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes.
Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.

Subgrade 3C.—Sloping, rolling, and hilly soils that can be irrigated only by very special methods; fairly well suited to nonirrigated field crops; need control of erosion.

Delhi sand, 8 to 15 percent slopes.
Montpellier coarse sandy loam, 3 to 8 percent slopes.
Montpellier coarse sandy loam, 8 to 15 percent slopes.
Snelling sandy loam, 8 to 15 percent slopes, eroded.
Snelling sandy loam, 15 to 30 percent slopes, eroded.
Whitney fine sandy loam, 3 to 8 percent slopes.
Whitney fine sandy loam, 3 to 8 percent slopes, eroded.
Whitney fine sandy loam, 8 to 15 percent slopes.
Whitney sandy loam, 3 to 8 percent slopes.
Whitney sandy loam, 8 to 15 percent slopes.
Whitney sandy loam, 8 to 15 percent slopes, eroded.
Whitney and Rocklin soils, 3 to 8 percent slopes, eroded.

Subgrade 3D.—Gently sloping, well-drained soils that are restricted by a slowly permeable, fine-textured substratum or by a hardpan; moderately well suited to special crops.

Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes.
Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied.
Hopeton clay loam, 0 to 3 percent slopes.
Hopeton clay loam, 3 to 8 percent slopes.
Montpellier coarse sandy loam, 0 to 3 percent slopes.
Porterville clay, 0 to 3 percent slopes.
Porterville clay, 3 to 8 percent slopes.
Rocklin loam, 0 to 3 percent slopes.
Rocklin loam, 3 to 8 percent slopes.
Rocklin sandy loam, 0 to 3 percent slopes.

GRADE 4.—SOILS POORLY SUITED TO GENERAL INTENSIVE AGRICULTURE

The range of crops is narrow and the yields are generally low. Most of these soils are marginal for agriculture.

Subgrade 4A.—Coarse-textured soils and miscellaneous land types that have a severe hazard of wind erosion, a high water table, or slight concentrations of soluble salts or alkali.

Columbia soils, channeled, 0 to 3 percent slopes.
Dello sand, slightly saline-alkali, 0 to 1 percent slopes.
Dune land, 0 to 3 percent slopes.
Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes.
Hilmar sand, poorly drained, 0 to 1 percent slopes.
Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes.
Tujunga sand, 0 to 3 percent slopes.
Tujunga sand, channeled, 0 to 8 percent slopes.

Subgrade 4B.—Poorly drained to well-drained soils that contain slight to moderate concentrations of soluble salts or alkali; fairly well suited to field crops, rice, and irrigated pasture; generally unsuited to orchards.

Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes.
Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes.
Foster fine sandy loam, 0 to 1 percent slopes.
Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
Fresno loam, slightly saline-alkali, 0 to 1 percent slopes.
Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes.
Landlow clay, 0 to 1 percent slopes.
Landlow clay, slightly saline-alkali, 0 to 1 percent slopes.
Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes.
Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes.
Lewis loam, slightly saline-alkali, 0 to 1 percent slopes.
Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes.
Madera loam, slightly saline-alkali, 0 to 1 percent slopes.
Merced clay, slightly saline, 0 to 1 percent slopes.
Merced clay, moderately saline, 0 to 1 percent slopes.
Merced clay loam, moderately saline, 0 to 1 percent slopes.
Pozo clay loam, 0 to 1 percent slopes.
Pozo clay loam, slightly saline, 0 to 1 percent slopes.
Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes.
Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes.
Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.

Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
Waukena loam, slightly saline-alkali, 0 to 1 percent slopes.

Subgrade 4C.—Soils that are limited by sloping to hilly topography; irrigation possible only by special methods; can be farmed to nonirrigated grain; need control of erosion.

Hopeton clay loam, 8 to 15 percent slopes.
Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded.
Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded.
Raynor clay, 8 to 15 percent slopes.
Raynor cobbly clay, 8 to 15 percent slopes.
Rocklin loam, 8 to 15 percent slopes.
Rocklin sandy loam, 8 to 15 percent slopes, eroded.
Sesame rocky loam, 8 to 30 percent slopes.
Whitney fine sandy loam, 8 to 15 percent slopes, eroded.
Whitney fine sandy loam, 15 to 30 percent slopes, eroded.
Whitney sandy loam, 15 to 30 percent slopes, eroded.
Whitney and Rocklin soils, 8 to 15 percent slopes, eroded.

Subgrade 4D.—Relatively shallow soils and miscellaneous land types of rather low fertility; suited only to special crops such as irrigated pasture, rice, or shallow-rooted field crops; yields can be increased by use of nitrogen or phosphate or both.

Auburn rocky silt loam, 3 to 8 percent slopes.
Bear Creek soils, 0 to 3 percent slopes.
Corning gravelly loam, 0 to 8 percent slopes.
Foster gravelly fine sandy loam, 0 to 1 percent slopes.
Hopeton clay, 0 to 8 percent slopes.
Hopeton gravelly clay loam, 0 to 8 percent slopes.
Madera fine sandy loam, 0 to 3 percent slopes.
Madera loam, 0 to 1 percent slopes.
Madera sandy loam, 0 to 3 percent slopes.
Madera sandy loam, 3 to 8 percent slopes.
Pentz clay loam, 0 to 8 percent slopes.
Pentz loam, 0 to 8 percent slopes.
Raynor clay, 0 to 3 percent slopes.
Raynor clay, 3 to 8 percent slopes.
Raynor cobbly clay, 0 to 3 percent slopes.
Raynor cobbly clay, 3 to 8 percent slopes.
Rocklin sandy loam, 3 to 8 percent slopes.
Rocklin sandy loam, 3 to 8 percent slopes, eroded.
San Joaquin loam, 0 to 3 percent slopes.
San Joaquin loam, 3 to 8 percent slopes.
San Joaquin sandy loam, 0 to 3 percent slopes.
San Joaquin sandy loam, 3 to 8 percent slopes.
San Joaquin-Alamo complex, 0 to 3 percent slopes.
Sesame rocky loam, 3 to 8 percent slopes.
Seville clay, 0 to 3 percent slopes.
Seville clay, 3 to 8 percent slopes.
Yokohl clay, 0 to 3 percent slopes.
Yokohl clay loam, 0 to 3 percent slopes.
Yokohl loam, 0 to 3 percent slopes..
Yokohl loam, 3 to 8 percent slopes.

Grade 5.—Soils Very Poorly Suited to Agriculture

These soils may be of value for pasture or for special crops, such as rice.

Subgrade 5A.—Imperfectly drained and poorly drained soils that range from nonsaline and nonalkali to strongly saline-alkali; very difficult to reclaim because of a high water table or a slowly permeable subsoil.

Alamo clay, 0 to 1 percent slopes.
Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes.
Dello sand, poorly drained, 0 to 1 percent slopes.
Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes.
Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes.
Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes.
Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes.
Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes.
Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes.
Lewis clay, slightly saline-alkali, 0 to 1 percent slopes.
Lewis loam, moderately saline-alkali, 0 to 1 percent slopes.
Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes.
Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes.
Pozo clay loam, moderately saline, 0 to 1 percent slopes.
Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes.
Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes.
Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.
Waukena loam, moderately saline-alkali, 0 to 1 percent slopes.

Subgrade 5B.—Soils and miscellaneous land types that are limited by gravel, cobblestones, rock outcrops, shallowness, or hilly topography; best suited to range.

Anderson gravelly soils, channeled, 0 to 3 percent slopes.
Corning cobbly loam, 3 to 8 percent slopes.
Corning cobbly loam, 8 to 30 percent slopes.
Corning gravelly loam, 8 to 30 percent slopes.
Corning gravelly loam, 8 to 30 percent slopes, eroded.
Corning gravelly loam, 30 to 45 percent slopes, eroded.
Corning gravelly sandy loam, 0 to 8 percent slopes.
Corning gravelly sandy loam, 8 to 30 percent slopes.
Corning gravelly sandy loam, 8 to 30 percent slopes, eroded.
Daulton rocky silt loam, 3 to 8 percent slopes.
Dune land, 3 to 8 percent slopes.
Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes.
Hornitos fine sandy loam, 3 to 8 percent slopes.
Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded.
Pentz clay loam, 8 to 30 percent slopes.
Pentz gravelly loam, 0 to 8 percent slopes.
Pentz gravelly loam, 8 to 30 percent slopes.
Pentz loam, 8 to 30 percent slopes.
Peters clay, 0 to 8 percent slopes.
Peters clay, 8 to 15 percent slopes.
Peters cobbly clay, 0 to 8 percent slopes.
Peters cobbly clay, 8 to 30 percent slopes.
Redding gravelly loam, 0 to 8 percent slopes.
Tujunga gravelly sand, channeled, 0 to 8 percent slopes.
Whiterock rocky silt loam, 3 to 8 percent slopes.
Whiterock rocky silt loam, 3 to 8 percent slopes, eroded.
Whiterock rocky silt loam, 8 to 30 percent slopes.
Whiterock rocky silt loam, 8 to 30 percent slopes, eroded.
Whitney fine sandy loam, 30 to 45 percent slopes, eroded.

Grade 6.—Nonagricultural Soils and Miscellaneous Land Types

These soils and land types are suited only to range of fair or poor quality.

Subgrade 6A.—Poorly drained to well drained soils that contain moderate to strong concentrations of soluble salts or salts and alkali.

Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes.
Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes.
Fresno loam, moderately saline-alkali, 0 to 1 percent slopes.

Fresno loam, strongly saline-alkali, 0 to 1 percent slopes.
Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes.
Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes.
Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes.
Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes.
Lewis clay, moderately saline-alkali, 0 to 1 percent slopes.
Lewis loam, strongly saline-alkali, 0 to 1 percent slopes.
Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes.
Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes.
Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes.
Rossi clay, strongly saline-alkali, 0 to 1 percent slopes.
Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes.
Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes.
Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes.
Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes.
Waukena loam, strongly saline-alkali, 0 to 1 percent slopes.

Subgrade 6B.—Soils and miscellaneous land types that are limited because they are very shallow, or have cobblestones, rock outcrops, or rolling to steep topography, or are low in fertility.

Amador loam, 0 to 8 percent slopes.
Amador loam, 8 to 30 percent slopes.
Amador loam, 30 to 45 percent slopes.
Corning gravelly sandy loam, 30 to 45 percent slopes, eroded.
Daulton rocky silt loam, 8 to 30 percent slopes, eroded.
Hornitos fine sandy loam, 8 to 30 percent slopes.
Hornitos fine sandy loam, 30 to 45 percent slopes.
Hornitos gravelly fine sandy loam, 0 to 8 percent slopes.
Hornitos gravelly fine sandy loam, 8 to 30 percent slopes.
Keyes gravelly clay loam, 0 to 8 percent slopes.
Keyes gravelly loam, 0 to 8 percent slopes.
Keyes gravelly loam, 8 to 15 percent slopes.
Keyes-Pentz gravelly loams, 0 to 8 percent slopes.
Pentz loam, 30 to 75 percent slopes.
Pits.
Redding cobbly loam, 0 to 8 percent slopes.
Redding gravelly loam, 8 to 30 percent slopes.
Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes.
Riverwash.
Sandstone rock land.
Schist rock land.
Slate rock land.
Tailings.
Terrace escarpments.
Tuff rock land.

Table 7 lists the soils of the Area and gives the suitability of each for the principal crops that are grown. In estimating the suitability of a soil for a particular crop, the following things were considered: (1) the requirements of the crop as to soil and climate; (2) the probable yield and quality of the crop under the management commonly practiced in the Area; (3) the feasibility of irrigation; and (4) the probable productive life of the crop if it is a perennial.

Although yield is not the only factor considered in estimating suitability, it is a major factor. Table 8 gives the estimated range in the average yield of each of the principal crops on soils of the various suitabilities given in table 7. A crop should not be planted on a soil that is very poorly suited to it, as a profitable yield is unlikely. However, a crop may succeed on a poorly suited soil under very special management or as a noncommercial home garden crop.

Capability Groups of Soils[8]

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and land forms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, grazing, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, stony, or saline and alkali; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units—groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping of soils for many statements about their management. In California the capability units are given numbers that correspond to the nature of the limitation considered in placing them in the capability class and subclass.

The numbers and the nature of the limitation indicated by each are as follows:

1. An erosion hazard, actual or potential.
2. A problem or limitation that results from wetness.
3. A problem or limitation that results from shallowness.
4. A problem or limitation that results from coarse texture, excessive gravel, or rock outcrops.
5. A problem or limitation that results from very fine texture.

[8] By RICHARD C. HUFF, soil scientist, Soil Conservation Service.

TABLE 7.—*Relative suitability of soils for principal crops in the Merced Area, California*

[VG—very good; G—good; F—fair; P—poor; and VP—very poor. See table 8 for estimated range in yields. All crops are irrigated except where otherwise stated]

Mapping unit	Alfalfa	Cotton	Barley		Sweet-potatoes	Truck crops	Grapes	Figs	Almonds	Peaches	Rice	Pasture	
			Irrigated	Not irrigated								Seeded and irrigated	Range not irrigated
Alamo clay, 0 to 1 percent slopes	P	P	P	P	VP	P	P	P	P	P	G	G	F
Amador loam, 0 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Amador loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Amador loam, 30 to 45 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
Anderson gravelly soils, channeled, 0 to 3 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Atwater sand, 0 to 3 percent slopes	F	F	F	VP	G	F	VG	F	VG	VG	P	F	P
Atwater sand, 3 to 8 percent slopes	F	F	F	VP	G	F	VG	F	VG	VG	VP	P	P
Atwater loamy sand, 0 to 3 percent slopes	G	P	G	VP	VG	F	VG	F	VG	VG	VG	F	P
Atwater loamy sand, 3 to 8 percent slopes	G	P	G	VP	VG	F	VG	F	VG	VG	VP	F	P
Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes	P	P	G	P	F	P	F	F	P	P	VP	G	G
Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes	G	F	G	P	VG	F	VG	G	VG	VG	P	F	P
Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes	F	P	G	F	G	P	F	F	F	F	P	G	F
Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes	G	F	G	P	VG	F	VG	G	VG	VG	VP	P	P
Auburn rocky silt loam, 3 to 8 percent slopes	P	P	P	F	P	P	P	P	P	P	VP	F	G
Bear Creek loam, 0 to 3 percent slopes	F	G	G	G	F	G	P	G	F	F	G	G	G
Bear Creek clay loam, 0 to 3 percent slopes	F	G	G	G	P	G	P	G	F	F	G	G	G
Bear Creek soils, 0 to 3 percent slopes	F	F	F	G	P	P	P	P	P	P	P	F	G
Borden fine sandy loam, 0 to 3 percent slopes	G	G	G	G	F	G	F	G	P	P	G	G	G
Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	F	G	F	G	F	F	F	F	P	P	F	G	F
Burchell silt loam, 0 to 1 percent slopes	G	VG	VG	G	F	G	P	G	P	P	VG	VG	VG
Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes	F	G	F	G	P	F	P	G	P	P	G	G	G
Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	F	G
Burchell silty clay loam, 0 to 1 percent slopes	G	VG	VG	G	P	F	VP	G	P	P	VG	VG	VG
Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	F	G	F	G	P	P	P	G	P	P	G	G	G
Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	P	P	P	P	P	F	F	G
Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes	G	VG	VG	VG	G	VG	G	G	P	P	VG	VG	VG
Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes	G	VG	VG	VG	F	VG	G	G	P	P	VG	VG	VG
Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes	G	F	G	G	F	G	P	F	P	P	VG	VG	G
Columbia soils, channeled, 0 to 3 percent slopes	P	P	P	F	P	P	P	P	P	P	P	P	G
Corning gravelly sandy loam, 0 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Corning gravelly sandy loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Corning gravelly sandy loam, 8 to 30 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P

TABLE 7.—*Relative suitability of soils for principal crops in the Merced Area, California*—Continued

Mapping unit	Alfalfa	Cotton	Barley		Sweet-potatoes	Truck crops	Grapes	Figs	Almonds	Peaches	Rice	Pasture	
			Irrigated	Not irrigated								Seeded and irrigated	Range not irrigated
Corning gravelly sandy loam, 30 to 45 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Corning gravelly loam, 0 to 8 percent slopes	P	P	P	P	P	P	P	P	P	P	P	P	F
Corning gravelly loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Corning gravelly loam, 8 to 30 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Corning gravelly loam, 30 to 45 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Corning cobbly loam, 3 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Corning cobbly loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Daulton rocky silt loam, 3 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Daulton rocky silt loam, 8 to 30 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Delhi sand, 0 to 3 percent slopes	P	P	P	VP	G	P	G	G	VG	G	P	P	P
Delhi sand, 3 to 8 percent slopes	P	P	P	VP	G	P	G	G	VG	G	VP	P	P
Delhi sand, 8 to 15 percent slopes	P	P	P	P	P	P	F	P	F	F	VP	P	F
Delhi loamy sand, 0 to 3 percent slopes	F	P	F	VP	G	F	VG	P	VG	VG	VP	P	P
Delhi loamy sand, 3 to 8 percent slopes	F	P	F	VP	G	F	VG	P	VG	VG	VP	P	P
Delhi loamy fine sand, 0 to 3 percent slopes	G	F	G	P	VG	F	VG	F	VG	VG	VP	F	P
Delhi loamy fine sand, 3 to 8 percent slopes	G	F	G	P	VG	F	VG	F	VG	VG	VP	F	P
Delhi sand, silty substratum, 0 to 3 percent slopes	F	F	F	P	G	F	VG	G	VG	VG	P	F	P
Delhi sand, silty substratum, 3 to 8 percent slopes	F	F	F	P	G	F	VG	G	VG	VG	VP	P	P
Delhi loamy sand, silty substratum, 0 to 3 percent slopes	G	P	G	VP	VG	F	VG	F	VG	VG	VP	F	P
Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes	G	G	G	F	VG	F	VG	F	VG	VG	VP	G	P
Dello sand, 0 to 1 percent slopes	P	P	P	P	F	P	F	F	G	F	P	F	F
Dello sand, slightly saline-alkali, 0 to 1 percent slopes	P	P	F	P	P	P	P	P	P	P	P	F	F
Dello sand, poorly drained, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	G	G
Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	G	G
Dello loamy fine sand, 0 to 1 percent slopes	P	F	F	F	F	P	F	F	P	P	VP	G	G
Dinuba sandy loam, 0 to 1 percent slopes	G	G	VG	F	G	G	VG	G	F	F	F	VG	G
Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes	F	G	F	F	P	P	P	F	P	P	F	G	F
Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes	F	P	P	P	P	P	P	P	P	P	F	F	G
Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	F	F	F
Dune land, 0 to 3 percent slopes	F	P	P	VP	G	P	F	P	F	F	P	P	P
Dune land, 3 to 8 percent slopes	P	VP	VP	VP	P	VP	P	P	P	P	VP	VP	VP
Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Foster fine sandy loam, 0 to 1 percent slopes	F	F	F	F	P	P	P	F	P	P	F	G	VG
Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	F	VG

Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	G	G
Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	G	G
Foster gravelly fine sandy loam, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	P	F	G
Fresno loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	P	P	P	F	P	P	F	F	F
Fresno loam, moderately saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Fresno loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	F	F
Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Grangeville fine sandy loam, 0 to 1 percent slopes	VG	VG	VG	VG	G	VG	G	G	P	P	P	VG	VG
Grangeville loam, 0 to 1 percent slopes	VG	VG	VG	VG	F	VG	G	G	P	P	F	VG	VG
Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	P	VP	P	P	F	P	P	F	G	VG
Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	VP	P	VP	VP	P	P	G
Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes	G	F	G	F	G	F	G	G	F	F	P	G	F
Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes	F	F	F	F	G	F	G	F	F	F	VP	F	G
Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied	P	P	P	F	P	P	P	P	P	P	VP	P	G
Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes	VP	P	P	G	P	P	P	P	P	P	F	G	G
Hanford sandy loam, 0 to 1 percent slopes	VG	VG	VG	G	VG	G	VG	VG	VG	VG	P	F	G
Hanford gravelly sandy loam, 0 to 1 percent slopes	G	G	G	F	P	P	G	G	G	G	P	G	VG
Hanford fine sandy loam, 0 to 1 percent slopes	VG	VG	VG	VG	VG	G	VG	VG	VG	VG	F	VG	VG
Hanford fine sandy loam, channeled, 0 to 8 percent slopes	G	G	G	G	G	G	G	G	G	F	P	G	VG
Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes	G	F	G	P	VG	G	G	G	G	G	P	P	G
Hilmar loamy sand, 0 to 3 percent slopes	G	F	G	VP	G	F	VG	F	F	P	VP	G	G
Hilmar loamy sand, slightly saline-alakli, 0 to 3 percent slopes	P	P	F	P	F	F	F	F	P	P	P	G	F
Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	F	P	P	P	P	P	P	P	P	P	F	F	F
Hilmar sand, 0 to 3 percent slopes	F	F	F	P	G	F	G	G	F	F	P	F	F
Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes	F	P	F	P	P	P	P	P	P	P	P	F	F
Hilmar sand, poorly drained, 0 to 1 percent slopes	F	P	F	P	P	P	P	P	P	P	F	F	F
Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	P	P	P	P	P	P	F	F
Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	VP	P	VP	VP	P	P	P
Honcut silt loam, 0 to 1 percent slopes	VG	VG	VG	VG	F	VG	G	VG	VG	G	F	VG	VG

TABLE 7.—*Relative suitability of soils for principal crops in the Merced Area, California*—Continued

Mapping unit	Alfalfa	Cotton	Barley		Sweet-potatoes	Truck crops	Grapes	Figs	Almonds	Peaches	Rice	Pasture	
			Irrigated	Not irrigated								Seeded and irrigated	Range not irrigated
Honcut silt loam, deep over hardpan, 0 to 1 percent slopes	G	VG	VG	VG	F	VG	G	VG	VG	VG	VG	VG	VG
Honcut fine sandy loam, 0 to 1 percent slopes	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	P	VG	VG
Honcut gravelly sandy loam, 0 to 1 percent slopes	G	G	G	F	P	P	G	G	G	G	P	G	VG
Honcut silty clay loam, 0 to 1 percent slopes	VG	VG	VG	VG	P	VG	F	VG	G	F	G	VG	G
Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes	VG	VG	VG	G	P	G	F	VG	G	F	VG	VG	VG
Honcut silty clay loam, channeled, 0 to 8 percent slopes	G	G	G	G	P	F	F	G	G	F	P	G	VG
Hopeton clay loam, 0 to 3 percent slopes	F	F	F	F	P	P	F	G	P	P	F	G	G
Hopeton clay loam, 3 to 8 percent slopes	F	P	F	F	P	P	F	G	P	P	VP	G	G
Hopeton clay loam, 8 to 15 percent slopes	P	P	P	F	P	P	P	P	P	P	VP	P	F
Hopeton gravelly clay loam, 0 to 8 percent slopes	P	P	P	P	P	P	P	P	P	P	VP	F	F
Hopeton clay, 0 to 8 percent slopes	F	F	F	F	P	P	P	G	P	P	F	G	F
Hornitos fine sandy loam, 3 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Hornitos fine sandy loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Hornitos fine sandy loam, 30 to 45 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Hornitos gravelly fine sandy loam, 0 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	P
Hornitos gravelly fine sandy loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Keyes gravelly loam, 0 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Keyes gravelly loam, 8 to 15 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Keyes gravelly clay loam, 0 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Keyes-Pentz gravelly loams, 0 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Landlow silty clay loam, 0 to 1 percent slopes	G	VG	VG	VG	P	F	P	G	P	P	VG	G	G
Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	VP	P	P	F	P	P	G	G	G
Landlow silt loam, 0 to 1 percent slopes	G	VG	VG	VG	F	G	F	G	P	P	VG	G	G
Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	P	P	P	F	P	P	G	G	G
Landlow clay, 0 to 1 percent slopes	F	G	F	F	VP	P	P	G	P	P	G	G	G
Landlow clay, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	VP	P	P	F	P	P	G	G	G
Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	P	P	P	P	P	P	P	G	F	G
Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	P	P	F	F	F
Lewis loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	P	VP	VP	P	P	P	P	G	F	G
Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	F	F	F

Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Lewis clay, slightly saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	F	F	F
Lewis clay, moderately saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Madera sandy loam, 0 to 3 percent slopes	G	G	G	F	F	F	F	F	F	F	P	G	F
Madera sandy loam, 3 to 8 percent slopes	F	F	F	F	F	F	F	F	F	F	VP	F	F
Madera fine sandy loam, 0 to 3 percent slopes	G	G	G	F	F	F	F	F	F	F	P	G	F
Madera loam, 0 to 1 percent slopes	G	G	G	F	F	F	F	F	F	F	F	G	G
Madera loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Marguerite loam, 0 to 1 percent slopes	VG	VG	VG	VG	G	VG	G	VG	VG	G	F	G	VG
Marguerite silty clay loam, 0 to 1 percent slopes	VG	VG	VG	VG	P	VG	F	VG	G	F	G	VG	G
Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes	G	VG	VG	G	P	G	F	G	F	F	VG	VG	G
Merced clay loam, slightly saline, 0 to 1 percent slopes	F	F	G	P	P	P	P	F	P	P	G	G	F
Merced clay loam, moderately saline, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes	F	G	G	G	P	P	P	F	P	P	G	G	F
Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Merced clay, slightly saline, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Merced clay, moderately saline, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Montpellier coarse sandy loam, 0 to 3 percent slopes	F	F	F	F	F	P	F	F	P	P	VP	F	G
Montpellier coarse sandy loam, 3 to 8 percent slopes	F	F	F	F	F	P	F	F	P	P	VP	F	G
Montpellier coarse sandy loam, 8 to 15 percent slopes	P	P	P	F	P	P	P	P	P	P	VP	P	G
Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	P	F
Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	VP	F
Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Pachappa sandy loam, 0 to 1 percent slopes	VG	VG	VG	G	VG	G	VG	VG	G	F	P	F	G
Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	F	G	F	P	P	P	P	F	P	P	P	G	G
Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes	G	G	G	F	G	G	G	G	F	F	F	G	G
Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	G	F	P	P	F	P	P	F	G	F
Pachappa fine sandy loam, 0 to 1 percent slopes	VG	VG	VG	VG	VG	G	VG	VG	G	F	P	G	VG
Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	F	G	F	P	P	P	P	F	P	P	P	G	G
Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes	G	G	G	F	G	G	G	G	F	F	F	G	G
Pentz loam, 0 to 8 percent slopes	P	P	P	P	P	P	P	P	P	P	VP	P	F
Pentz loam, 8 to 30 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Pentz loam, 30 to 75 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Pentz gravelly loam, 0 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Pentz gravelly loam, 8 to 30 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Pentz clay loam, 0 to 8 percent slopes	P	P	P	P	P	P	P	P	P	P	VP	P	F
Pentz clay loam, 8 to 30 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	F
Peters clay, 0 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	G
Peters clay, 8 to 15 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	G
Peters cobbly clay, 0 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	G
Peters cobbly clay, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	G

TABLE 7.—*Relative suitability of soils for principal crops in the Merced Area, California*—Continued

Mapping unit	Alfalfa	Cotton	Barley		Sweet-potatoes	Truck crops	Grapes	Figs	Almonds	Peaches	Rice	Pasture	
			Irrigated	Not irrigated								Seeded and irrigated	Range not irrigated
Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	G	G	F	F	P	P	P	F	P	P	P	G	F
Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes	P	P	P	P	P	P	P	P	P	P	P	F	F
Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	P	P	P
Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Pits	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Porterville clay, 0 to 3 percent slopes	F	F	F	F	VP	P	F	G	P	P	F	G	G
Porterville clay, 3 to 8 percent slopes	F	F	F	F	VP	P	F	G	P	P	VP	F	G
Pozo clay loam, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Pozo clay loam, slightly saline, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Pozo clay loam, moderately saline, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	F	G
Raynor clay, 0 to 3 percent slopes	F	F	F	F	VP	P	P	F	P	P	F	F	G
Raynor clay, 3 to 8 percent slopes	F	F	F	F	VP	P	P	F	P	P	P	F	G
Raynor clay, 8 to 15 percent slopes	P	P	P	P	VP	P	P	P	P	P	VP	P	F
Raynor cobbly clay, 0 to 3 percent slopes	P	P	P	P	VP	P	P	F	P	P	F	F	G
Raynor cobbly clay, 3 to 8 percent slopes	P	P	P	P	VP	P	P	F	P	P	VP	F	G
Raynor cobbly clay, 8 to 15 percent slopes	P	P	P	P	VP	P	P	P	P	P	VP	P	F
Redding gravelly loam, 0 to 8 percent slopes	VP	VP	VP	P	VP	VP	VP	VP	VP	VP	VP	VP	P–F
Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	G
Redding gravelly loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Redding cobbly loam, 0 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Riverwash	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
Rocklin loam, 0 to 3 percent slopes	F	F	F	F	F	P	P	P	P	P	VP	G	G
Rocklin loam, 3 to 8 percent slopes	F	F	F	F	F	P	P	P	P	P	VP	F	G
Rocklin loam, 8 to 15 percent slopes	P	P	P	F	P	P	P	P	P	P	VP	P	F
Rocklin sandy loam, 0 to 3 percent slopes	F	F	F	F	F	P	P	P	P	P	VP	G	G
Rocklin sandy loam, 3 to 8 percent slopes	F	P	P	F	P	P	F	F	P	P	VP	F	F
Rocklin sandy loam, 3 to 8 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	F	F
Rocklin sandy loam, 8 to 15 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	P	F
Rossi clay, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	P	P	F
Rossi clay, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	G	G	G
Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	P	P	F
Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Ryer silt loam, 0 to 3 percent slopes	G	G	G	G	G	G	G	G	G	G	F	VG	G
Ryer clay loam, 0 to 3 percent slopes	G	G	VG	F	P	G	F	G	G	F	F	G	G
Ryer clay loam, 3 to 8 percent slopes	F	F	G	G	P	F	G	G	F	F	P	F	F
Sandstone rock land	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
San Joaquin sandy loam, 0 to 3 percent slopes	F	F	F	F	P	P	P	P	P	P	F	G	F

San Joaquin sandy loam, 3 to 8 percent slopes	F	P	P	F	P	P	P	P	P	P	P	F	F
San Joaquin loam, 0 to 3 percent slopes	F	F	F	F	P	P	P	P	P	P	F	G	F
San Joaquin loam, 3 to 8 percent slopes	F	P	P	F	P	P	P	P	P	P	P	F	F
San Joaquin-Alamo complex, 0 to 3 percent slopes	P	F	F	F	P	P	P	P	P	P	F	G	F
Schist rock land	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
Sesame rocky loam, 3 to 8 percent slopes	P	P	P	F	P	P	P	P	P	P	VP	P	F
Sesame rocky loam, 8 to 30 percent slopes	P	P	P	F	P	P	P	P	P	P	VP	P	F
Seville clay, 0 to 3 percent slopes	F	F	F	F	VP	P	P	F	P	P	F	G	F
Seville clay, 3 to 8 percent slopes	F	P	P	F	VP	P	P	F	P	P	P	F	F
Slate rock land	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
Slickens	G	G	G	F	P	P	F	G	P	P	G	G	F
Snelling sandy loam, 0 to 3 percent slopes	G	G	G	G	VG	G	G	F	VG	G	VP	G	F
Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes	F	F	G	G	F	P	F	F	F	F	P	G	F
Snelling sandy loam, 3 to 8 percent slopes	F	F	F	G	F	F	G	G	VG	G	P	F	F
Snelling sandy loam, 3 to 8 percent slopes, eroded	F	P	F	F	F	F	F	F	G	F	P	F	F
Snelling sandy loam, 8 to 15 percent slopes	P	P	P	G	P	P	F	P	F	F	VP	F	G
Snelling sandy loam, 8 to 15 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	P	F
Snelling sandy loam, 15 to 30 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	VP	F
Tailings	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
Temple loam, 0 to 1 percent slopes	G	VG	VG	F	F	G	P	F	P	P	G	VG	G
Temple loam, slightly saline, 0 to 1 percent slopes	G	VG	VG	F	F	F	P	F	P	P	G	VG	G
Temple clay loam, 0 to 1 percent slopes	G	VG	VG	F	P	F	P	F	P	P	VG	VG	G
Temple clay loam, slightly saline, 0 to 1 percent slopes	G	VG	VG	F	P	F	P	F	P	P	VG	VG	G
Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes	F	VG	G	VG	P	P	P	F	P	P	P	F	G
Terrace escarpments	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	G	P	P	P	P	F	P	P	F	F	F
Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	P	F
Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	G	P	VP	VP	VP	F	VP	VP	F	F	F
Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	P	P	P	P	P	P	F	P	F
Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Tuff rock land	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP
Tujunga sand, 0 to 3 percent slopes	F	F	F	P	G	P	F	F	F	P	VP	P	F
Tujunga sand, channeled, 0 to 8 percent slopes	F	P	P	P	P	P	P	P	P	P	VP	P	F
Tujunga gravelly sand, channeled, 0 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Tujunga loamy sand, 0 to 3 percent slopes	F	P	F	VP	G	F	VG	P	VG	VG	VP	P	P
Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	F	F	G
Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	P	P	F
Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Waukena loam, slightly saline-alkali, 0 to 1 percent slopes	F	F	F	F	P	P	P	P	P	P	F	F	G
Waukena loam, moderately saline-alkali, 0 to 1 percent slopes	P	P	P	P	VP	VP	P	P	VP	VP	P	P	F

TABLE 7.—*Relative suitability of soils for principal crops in the Merced Area, California*—Continued

Mapping unit	Alfalfa	Cotton	Barley		Sweetpotatoes	Truck crops	Grapes	Figs	Almonds	Peaches	Rice	Pasture	
			Irrigated	Not irrigated								Seeded and irrigated	Range not irrigated
Waukena loam, strongly saline-alkali, 0 to 1 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Whiterock rocky silt loam, 3 to 8 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Whiterock rocky silt loam, 3 to 8 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Whiterock rocky silt loam, 8 to 30 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Whiterock rocky silt loam, 8 to 30 percent slopes, eroded	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	P
Whitney fine sandy loam, 3 to 8 percent slopes	G	F	G	G	G	F	G	G	G	G	VP	F	G
Whitney fine sandy loam, 3 to 8 percent slopes, eroded	F	P	F	F	F	P	F	F	F	F	VP	P	G
Whitney fine sandy loam, 8 to 15 percent slopes	F	P	P	G	P	P	F	F	F	P	VP	P	G
Whitney fine sandy loam, 8 to 15 percent slopes, eroded	P	P	P	G	P	P	P	P	P	P	VP	P	G
Whitney fine sandy loam, 15 to 30 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	VP	F
Whitney fine sandy loam, 30 to 45 percent slopes	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP	F
Whitney sandy loam, 3 to 8 percent slopes	G	F	G	G	G	F	G	G	G	G	VP	G	G
Whitney sandy loam, 8 to 15 percent slopes	F	P	P	G	P	P	F	F	F	P	VP	P	G
Whitney sandy loam, 8 to 15 percent slopes, eroded	F	P	P	G	P	P	F	F	F	P	VP	P	G
Whitney sandy loam, 15 to 30 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	VP	F
Whitney and Rocklin soils, 3 to 8 percent slopes, eroded	F	F	F	F	P	P	P	P	P	P	VP	F	G
Whitney and Rocklin soils, 8 to 15 percent slopes, eroded	P	P	P	F	P	P	P	P	P	P	VP	P	F
Wyman loam, 0 to 3 percent slopes	VG	VG	VG	VG	G	VG	G	VG	VG	G	F	G	VG
Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes	VG	VG	VG	P	G	VG	G	VG	VG	G	VP	G	G
Wyman loam, deep over hardpan, 0 to 3 percent slopes	G	VG	VG	VG	G	VG	G	VG	VG	VG	VG	VG	VG
Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes	G	G	G	G	P	P	P	G	P	P	G	G	G
Wyman clay loam, 0 to 3 percent slopes	VG	VG	VG	VG	P	VG	F	VG	G	F	G	VG	G
Wyman clay loam, deep over hardpan, 0 to 1 percent slopes	VG	VG	VG	G	P	G	F	G	G	F	VG	VG	VG
Yokohl loam, 0 to 3 percent slopes	F	F	F	F	F	F	F	G	F	F	F	G	G
Yokohl loam, 3 to 8 percent slopes	F	F	F	F	P	P	F	G	F	F	VP	F	G
Yokohl clay loam, 0 to 3 percent slopes	F	F	F	F	P	F	F	G	F	F	G	G	G
Yokohl clay, 0 to 3 percent slopes	F	F	F	F	P	P	F	G	F	F	G	G	F
Yolo loam, 0 to 1 percent slopes	VG	VG	VG	VG	G	VG	G	VG	VG	G	F	G	VG
Yolo loam, deep over hardpan, 0 to 1 percent slopes	G	VG	VG	VG	G	VG	G	VG	VG	VG	VG	VG	VG

TABLE 8.—*Estimated range in average yields per acre of principal crops under present management on soils of various suitabilities for crop production in the Merced Area, California*

Crop	Estimated yields for soil rated in table 7 as—				
	Very poor	Poor	Fair	Good	Very good
		Less than—			*More than—*
Alfalfa hay, irrigated ... tons	([1])	3.5	3.5 to 5	5 to 7	7
Almonds, irrigated ... 100-lb. sacks	([1])	4	4 to 8	8 to 12	12
Barley:					
Irrigated ... 100-lb. sacks	([1])	11	11 to 18	18 to 25	25
Nonirrigated ... 100-lb. sacks	([1])	7	7 to 12	12 to 16	16
Cotton, irrigated ... 100 lb. of lint	([1])	3	3 to 6	6 to 9	9
Figs, irrigated:					
Adriatic ... tons when dried	([1])	.75	.75 to 1.5	1.5 to 2	2
Calimyrna ... tons when dried	([1])	.5	.5 to .75	.75 to 1	1
Kadota ... tons when fresh	([1])	4	4 to 5	5 to 6	6
Mission ... tons when dried	([1])	1	1 to 1.5	1.5 to 2.5	2.5
Grapes, irrigated:					
Raisin and sweet wine ... tons when fresh	([1])	4	4 to 6	6 to 10	10
Dry wine ... tons when fresh	([1])	2.5	2.5 to 5	5 to 8	8
Pasture:					
Seeded and irrigated ... cow-acre-days [2]	([1])	200	200 to 300	300 to 400	400
Nonirrigated range ... cow-acre-days [2]	7.5	12	12 to 20	20 to 30	30
Peaches, irrigated ... tons when fresh	([1])	5	5 to 10	10 to 15	15
Rice, irrigated ... 100-lb. sacks	([1])	25	25 to 35	35 to 50	50
Sweetpotatoes, irrigated ... tons	([1])	2	2 to 4	4 to 6	6
Tomatoes, irrigated ... tons when fresh	([1])	6	6 to 9	9 to 15	15

[1] Very low yields or no yields of commercial importance.
[2] The number of animal units per acre, multiplied by the number of days grazing in a year or season. An animal unit is 1 horse, 1 cow, 1 steer, 5 sheep, or 5 goats.

6. A problem or limitation that results from salts or alkali.
7. A problem or limitation that results from reduced permeability of the subsoil.
8. A problem or limitation that results from a combination of salts and alkali and shallowness.
9. A problem or limitation that results from very low fertility.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations, but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soil, and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this Area, are described in the list that follows.

Class I.—Soils that are very good for crops and have few limitations that restrict their use.

Unit I–1.—Soils that have no limitations for intensive agriculture; well drained, moderately coarse textured to moderately fine textured, very deep, and of moderately high fertility.

Class II.—Soils that have some limitations that reduce the choice of plants or that make some conservation practices necessary.

Subclass IIe.—Soils that are moderately limited by hazard of erosion if they are tilled and not protected.

Unit IIe–1.—Well-drained, gently sloping, moderately coarse textured to moderately fine textured, very deep, permeable soils of moderately high fertility and a slight erosion hazard.

Unit IIe–4.—Well-drained, coarse textured and moderately coarse textured, very deep, moderately rapidly permeable soils on alluvial fans and flood plains.

Subclass IIw.—Soils that are moderately limited by excess water.

Unit IIw–2.—Imperfectly drained to poorly drained, moderately coarse textured to moderately fine textured, very deep soils on alluvial fans and flood plains.

Unit IIw–3.—Imperfectly drained, moderately coarse textured and medium textured, moderately deep and deep soils on alluvial fans and flood plains.

Subclass IIs.—Soils that are moderately limited by low moisture-holding capacity or other soil characteristics.

Unit IIs–3.—Well-drained, moderately coarse textured to moderately fine textured, deep soils on alluvial fans.

Unit IIs–4.—Well-drained, moderately coarse textured, gravelly, very deep, rapidly permeable soils on alluvial fans and flood plains.

Unit IIs–6.—Well-drained, moderately coarse textured, very deep, slightly saline-alkali soils on alluvial fans and flood plains.

Unit IIs–7.—Well-drained, moderately coarse textured to moderately fine textured, deep, moderately permeable to slowly permeable soils on low terraces.

Class III.— Soils that have severe limitations that reduce the choice of plants, or that make special conservation practices necessary, or both.
- Subclass IIIe.—Soils that are limited by hazard of erosion if they are tilled and not protected.
  - Unit IIIe–1.—Gently sloping to rolling, moderately coarse textured, deep, moderately permeable soils on older terraces.
  - Unit IIIe–4.—Well drained to somewhat excessively drained, level to gently sloping, coarse-textured, moderately deep to very deep, moderately permeable to rapidly permeable soils on flood plains and wind-modified alluvial fans.
- Subclass IIIw.—Soils that are severely limited by excess water.
  - Unit IIIw–2.—Imperfectly drained to poorly drained, moderately coarse textured to moderately fine textured soils in the basin area and on alluvial fans; moderately deep to deep; moderately permeable to slowly permeable.
  - Unit IIIw–4.—Imperfectly drained, coarse-textured, moderately deep to very deep soils on wind-modified alluvial fans.
  - Unit IIIw–5.—Imperfectly drained and poorly drained, fine-textured, slowly permeable soils in the basin area and on old alluvial fans.
  - Unit IIIw–6.—Imperfectly drained and poorly drained, moderately coarse textured to moderately fine textured, deep, slightly to moderately saline-alkali soils in the basin area.
- Subclass IIIs.—Soils that are severely limited by low moisture-holding capacity or fine texture.
  - Unit IIIs–5.—Well-drained, nearly level to gently sloping, fine-textured, shallow to moderately deep, slowly permeable soils on terraces and low foothills.
  - Unit IIIs–6.—Well-drained, moderately coarse textured to moderately fine textured, deep, slightly to moderately saline-alkali soils on alluvial fans and flood plains.
  - Unit IIIs–8.—Imperfectly drained, medium textured to moderately fine textured, shallow, slightly saline-alkali soils in the basin area.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, that make very careful management necessary, or both.
- Subclass IVe.—Soils that are very severely limited by hazard of erosion if they are tilled and not protected.
  - Unit IVe–1.—Rolling, moderately coarse textured soils on older terraces and lower foothills; moderately deep to deep; slowly to moderately rapidly permeable.
  - Unit IVe–3.—Rolling, moderately coarse textured to moderately fine textured, predominantly shallow, slowly permeable soils on older, more dissected alluvial fans and terraces.
  - Unit IVe–4.—Excessively drained, coarse-textured, very deep, very rapidly permeable soils and miscellaneous land types on flood plains and wind-modified alluvial fans.
  - Unit IVe–5.—Well-drained, sloping to hilly, fine-textured, shallow and moderately deep soils on old terraces and uplands.
- Subclass IVw.—Soils that are very severely limited by excess water.
  - Unit IVw–4.—Poorly drained, coarse-textured, moderately deep to very deep soils on wind-modified alluvial fans.
  - Unit IVw–6.—Imperfectly drained to poorly drained, moderately coarse textured to moderately fine textured soils in the basin area; moderately deep, moderately to strongly saline-alkali.
- Subclass IVs.—Soils that are very severely limited by shallowness, low moisture-holding capacity, or strong concentrations of salts and alkali.
  - Unit IVs–3.—Well-drained, level to gently sloping, moderately coarse textured to moderately fine textured, shallow, very slowly permeable soils on terraces and uplands.
  - Unit IVs–6.—Well-drained, moderately coarse textured to moderately fine textured, deep, moderately to strongly saline-alkali soils in the basin area.
  - Unit IVs–8.—Imperfectly drained, moderately coarse textured to moderately fine textured, shallow, slightly to moderately saline-alkali soils in the basin area.

Class V.—Soils that have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover. There are no class V soils in the Merced Area.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use chiefly to pasture, range, woodland, or wildlife food and cover.
- Subclass VIe.—Soils that are not suitable for cultivation and are limited chiefly by the hazard of erosion.
  - Unit VIe–4.—Moderately steep, moderately deep, moderately coarse textured to medium textured soils on older terraces and lower foothills.
  - Unit VIe–5.—Gently sloping to hilly, cobbly, fine-textured, slowly permeable soils on foothills.
  - Unit VIe–9.—Rolling to hilly, moderately coarse textured to medium textured, shallow, slowly permeable, infertile soils on dissected terraces.
- Subclass VIw.—Soils that are not suitable for cultivation and are limited chiefly by excess water.
  - Unit VIw–4.—Poorly drained, coarse-textured, moderately deep, moderately to strongly saline-alkali soils in depressions.
  - Unit VIw–6.—Poorly drained and very poorly drained, moderately coarse textured to fine textured, moderately rapidly to slowly permeable, slightly to strongly saline-alkali soils in the basin area.
- Subclass VIs.—Soils that are not suitable for cultivation and are limited chiefly by shallowness and low moisture-holding capacity.
  - Unit VIs–8.—Imperfectly drained to poorly drained, moderately coarse textured to fine textured, shallow, moderately and strongly saline-alkali soils in the basin area.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use chiefly to pasture, woodland, or wildlife shelter.

Subclass VIIe.—Soils that are very severely limited by risk of erosion if not protected.

Unit VIIe-3.—Rolling to hilly, medium textured to moderately fine textured, shallow, moderately permeable soils on foothills.

Unit VIIe-9.—Well drained to excessively drained, undulating to steep, moderately coarse textured and medium textured, very shallow to shallow soils on uplands and dissected old alluvial fans.

Class VIII.—Soils and land forms that have limitations that preclude their use for commercial plants and that restrict their use to recreation, wildlife shelter, water supply, or scenery.

Subclass VIIIs.—Soils that have very severe limitations that cannot be corrected.

Unit VIIIs-1.—Miscellaneous land types, nonagricultural.

Capability unit I-1

Soils that have no limitations for intensive agriculture; well drained, moderately coarse textured to moderately fine textured, very deep, and of moderately high fertility

These are the best agricultural soils of the Area. They occupy the better drained parts of the more recent and slightly older alluvial fans and flood plains. Slopes are very gentle.

Runoff is very slow to slow, and internal drainage is medium to rapid. The profiles are very deep and fairly uniform.

The soils in this unit are—

(HaA) Hanford fine sandy loam, 0 to 1 percent slopes.
(HeA) Hanford sandy loam, 0 to 1 percent slopes.
(HrA) Honcut fine sandy loam, 0 to 1 percent slopes.
(HtA) Honcut silt loam, 0 to 1 percent slopes.
(HwA) Honcut silty clay loam, 0 to 1 percent slopes.
(MeA) Marguerite loam, 0 to 1 percent slopes.
(MfA) Marguerite silty clay loam, 0 to 1 percent slopes.
(PaA) Pachappa fine sandy loam, 0 to 1 percent slopes.
(PdA) Pachappa sandy loam, 0 to 1 percent slopes.
(Sk) Slickens.
(WoA) Wyman clay loam, 0 to 3 percent slopes.
(WrA) Wyman loam, 0 to 3 percent slopes.
(YdA) Yolo loam, 0 to 1 percent slopes.

Use and management.—The choice of crops is wider on these soils than on those of any other capability unit in the Area. All crops that are suitable for this climate and that require good drainage do well on these soils. All of the common irrigated row crops, grain crops, grapes, deciduous fruit and nut crops, and pasture plants are grown or can be grown.

The natural fertility of these soils is moderately high, but the content of organic matter and nitrogen is low. Adding phosphorus and sulfur improves the quality of legumes but may not increase the yield. The content of potassium is generally adequate for most crops, but potatoes and some other specialty crops respond to potash at high levels of management. Nonleguminous plants generally respond to the addition of nitrogen. The content of organic matter can be increased and maintained by the use of green-manure crops, crop rotations, and crop residues. The supply of minor elements is generally adequate, but a few symptoms of zinc and manganese deficiency occur, especially where grapes, almonds, and peaches are grown.

Excessive cultivation and excessive irrigation can cause formation of a plowsole, which results in poor infiltration of water. In most places leveling for irrigation is not difficult and does little permanent damage.

Erosion is not a problem if reasonable care is used. Some of the coarser textured soils are susceptible to wind erosion if they are not managed properly.

Nematodes are a problem in some places and on some crops. Effective methods have been developed for protecting some crops against damage by nematodes.

Capability unit IIe-1

Well-drained, gently sloping, moderately coarse textured to moderately fine textured, very deep, permeable soils of moderately high fertility and a slight erosion hazard

These soils are similar to the soils in unit I-1, except that they are cut by channels that carry water only during flood periods.

The soils in this unit are—

(HcB) Hanford fine sandy loam, channeled, 0 to 8 percent slopes.
(HzA) Honcut silty clay loam, channeled, 0 to 8 percent slopes.

Use and management.—These soils are suited to the same crops as the soils in unit I-1 and require the same management practices to maintain productivity and to increase the content of organic matter.

The chief management problem is that of controlling water on the short slopes of the channel banks. In some places cultivation is carried across the channels and crops are planted on the sloping banks.

Irrigation water should be applied carefully, using contour furrows or sprinklers, so that the water will enter the soil and will not run off and cause erosion. Some system of collecting and safely disposing of excess water is necessary. Dikes or furrows should be used to prevent erosion by controlling runoff from the surrounding areas. Sheet erosion can be controlled by cross-slope tillage, stubble mulching, cover crops, and other fairly simple means.

Deep cuts can be made, to level these soils for irrigation or to smooth irregularities of slope, without doing permanent damage.

Capability unit IIe-4

Well-drained, coarse textured and moderately coarse textured, very deep, moderately rapidly permeable soils on alluvial fans and flood plains

These soils are coarser textured, more rapidly drained, and more droughty than the soils in unit I-1. The Atwater soils have a coarse surface layer and a sandy clay loam subsoil that prevents very rapid internal drainage. The Hanford soil has a moderate moisture-holding capacity in the upper part of its profile, but it drains readily because of the underlying sand.

The soils in this unit are—

(AfA) Atwater loamy sand, 0 to 3 percent slopes.
(AfB) Atwater loamy sand, 3 to 8 percent slopes.
(HbA) Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes.

Use and management.—These soils are best suited to crops that require sandy, well-aerated soils—for example, sweetpotatoes, alfalfa, grapes, and tree fruits and nuts.

These soils are low in fertility and very low in organic matter and nitrogen. Zinc deficiency is common in the sandier places. Phosphate fertilizer is used on alfalfa. Alfalfa also responds to sulfur. Because leaching is rapid, split applications of nitrogen are likely to be more helpful than a single heavy application. The content of organic matter can be maintained by using crop residues, crop rotations, and green-manure crops.

The water-holding capacity is moderate. Frequent, light applications of irrigation water are advisable. Sprinklers should be used, or short runs and narrow checks. Contour checks or sprinklers should be used in the more strongly sloping areas of Atwater loamy sand.

Wind erosion is a serious problem, especially on the Atwater soils. A protective cover of plants or mulch should be maintained as much of the time as possible. Cover crops planted in the fall and worked down as a mulch in the spring help to provide protection. All crop residues should be used for mulch.

Capability unit IIw-2

Imperfectly drained to poorly drained, moderately coarse textured to moderately fine textured, very deep soils on alluvial fans and flood plains

These soils are in many respects similar to those in unit I-1, but they occupy lower and more recent alluvial fans and flood plains. They are suitable for fewer crops than the soils in unit I-1, because of drainage problems.

These soils developed under conditions of poor or imperfect drainage. The present drainage has been improved and the water table generally lowered as a result of the building of Friant Dam and the dams of the Merced Stream Group for flood control. Nevertheless, excessive local use of irrigation water, movement of water from higher lying areas, or a slowly permeable substratum can still produce an occasional high or perched water table.

These soils have no serious problems of salts, alkali, or erosion.

The soils in this unit are—

(BgA) Burchell silt loam, 0 to 1 percent slopes.
(BkA) Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes.
(BnA) Burchell silty clay loam, 0 to 1 percent slopes.
(BpA) Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes.
(CaA) Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes.
(CcA) Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes.
(GaA) Grangeville fine sandy loam, 0 to 1 percent slopes.
(GbA) Grangeville loam, 0 to 1 percent slopes.
(GcA) Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes.
(MpA) Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes.
(PpA) Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes.
(TbA) Temple clay loam, 0 to 1 percent slopes.
(TcA) Temple clay loam, slightly saline, 0 to 1 percent slopes.
(TeA) Temple loam, 0 to 1 percent slopes.
(TfA) Temple loam, slightly saline, 0 to 1 percent slopes.

Use and management.—The crops that are suitable to this climate do as well on these soils as they do on the soils in unit I-1, but the choice is narrowed by the hazard of an occasional high water table. Especially restricted are the longer lived, deeper rooted crops, such as alfalfa and the deciduous fruit and nut trees. Irrigated pasture, row crops, and grain are the most suitable crops.

These soils are moderately high in fertility, and they contain more organic matter and more nitrogen than the soils in unit I-1. Nonleguminous crops respond to the addition of nitrogen. The quality of legumes is improved and the yields may be increased by the addition of phosphorus and sulfur. The supply of potassium is generally adequate for most crops, but adding potash might benefit some specialty crops, such as potatoes, at the highest levels of management. There are no known deficiencies or excesses of minor elements for the common crops. The content of organic matter can be maintained by the use of crop rotations, green-manure crops, and crop residues.

The water table in these soils can be kept at a fairly constant level by the use of open or tile drains. It is not advisable to plant deciduous fruit and nut trees until the water table and the floodwaters are controlled to some degree. Irrigation water should be applied carefully, to conserve water and to prevent the occurrence of a temporary perched or high water table. Provision should be made to dispose of excess surface water.

Except where these soils have been channeled by stream meanders, not much leveling needs to be done. Most areas can be leveled with little damage to the soil.

Erosion is not a problem.

Capability unit IIw-3

Imperfectly drained, moderately coarse textured and medium textured, moderately deep and deep soils on alluvial fans and flood plains

These soils have an overwash of recent deposits that are lighter colored, coarser textured, more rapidly permeable, and somewhat lower in water-holding capacity than the older substratum that they have covered. The thickness of the overlying material is 30 to 40 inches in most places, but it ranges from about 24 to 48 inches. Drainage is imperfect. Some soils have slight problems of excess salts and alkali.

The soils in this unit are—

(CbA) Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes.
(DpA) Dinuba sandy loam, 0 to 1 percent slopes.
(DrA) Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—The range of crops that are suited to these soils is restricted by the shallowness of the rooting zone and the hazard of a temporary perched water table and waterlogging. The problems of use and management are similar to those of the soils in unit IIw-2, but they are more serious because these soils are shallower and have a more slowly permeable substratum.

The best suited crops are irrigated row crops, grain, and pasture. The deeper rooted, longer lived, deciduous fruit and nut trees are not suited to these soils. Alfalfa will be short lived.

These soils are moderately high in fertility, but they are low in organic matter and nitrogen. Legumes benefit from the addition of phosphorus and sulfur. Plants

other than legumes are most likely to respond to nitrogen. The supply of potassium is generally adequate for most crops, but specialty crops such as potatoes may respond at the highest levels of management. The supply of minor elements is adeqate for most crops. The content of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

Careful irrigation practices are necessary. Frequent but small applications of water are advisable to prevent a perched water table, temporary waterlogging, or reduced aeration. Surface drainage is necessary, but subsurface drainage is not practical. Leveling for irrigation generally is not difficult and does little damage.

Capability unit IIs-3

Well-drained, moderately coarse textured to moderately fine textured, deep soils on alluvial fans

These soils are similar to those in unit I-1, except that each has slowly permeable material—either a hardpan or a semiconsolidated substratum—at a depth of more than 36 inches. Internal drainage is medium above the slowly permeable material and slow or very slow through it. Irrigation, unless very carefully managed, can result in temporary waterlogging and other drainage problems.

All of these soils are very gently sloping except Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes. If the mounds on this soil are leveled, it is like the other soils in this unit.

Concentrations of salts and alkali are not a problem on these soils. The hazard of erosion is slight.

The soils in this unit are—

(GfA) Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes.
(GfB) Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes.
(HuA) Honcut silt loam, deep over hardpan, 0 to 1 percent slopes.
(HxA) Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes.
(MgA) Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes.
(PcA) Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes.
(PgA) Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes.
(PfA) Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.
(WnA) Wyman clay loam, deep over hardpan, 0 to 1 percent slopes.
(WsA) Wyman loam, deep over hardpan, 0 to 3 percent slopes.
(WpA) Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.
(WtA) Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes.
(YeA) Yolo loam, deep over hardpan, 0 to 1 percent slopes.

Use and management.—Irrigated row crops, grain, grapevines, deciduous fruit and nut trees, and pasture plants are best suited to these soils. These soils are not so well suited to the very deep rooted crops as the soils in unit I-1, because of the slowly permeable substratum.

The natural fertility is moderately high. The content of organic matter and nitrogen is low. The requirements for fertilizer are like those of the soils in unit I-1. The content of organic matter can be maintained by using green-manure crops, crop rotations, and crop residues.

Excessive cultivation may result in the formation of a plowsole, which reduces the infiltration of water and causes poor aeration.

Proper management of irrigation water is important, to prevent waterlogging of the soil and seepage into lower lying areas. Light, frequent applications of water are advisable. Surface drainage should be provided.

Leveling for irrigation is generally not difficult. Moderate cuts can be made in most places without appreciable damage to the soil. If deeper cuts are made, the possibility of breaking up the substratum should be considered. The deeper rooted crops, such as fruit trees and nut trees, benefit most by elimination of the hardpan. If the hardpan is at a depth of more than 3 feet, and if the soil is carefully irrigated and well fertilized, the hardpan has little effect on shallow-rooted crops.

Capability unit IIs-4

Well-drained, moderately coarse textured, gravelly, very deep, rapidly permeable soils on alluvial fans and flood plains

These soils are gravelly throughout. Consequently, they drain more rapidly than the soils in unit I-1, they are more droughty, and they may have lower fertility.

The soils in this unit are—

(HdA) Hanford gravelly sandy loam, 0 to 1 percent slopes.
(HsA) Honcut gravelly sandy loam, 0 to 1 percent slopes.

Use and management.—The soils in this unit are suited to the same crops as the soils in unit I-1.

These soils are low in fertility, organic matter, and nitrogen. Because fertilizers leach away so rapidly, split applications of nitrogen are better than a single heavy application. Legumes respond to phosphate and sulfur fertilizers. Frequent light applications are advisable. Overirrigation leaches the soil of nutrients.

Other management needs are the same as for the soils in unit I-1.

Capability unit IIs-6

Well-drained, moderately coarse textured, very deep, slightly saline-alkali soils on alluvial fans and flood plains

Except for the presence of slight amounts of excess salts and alkali, the soils in this unit are similar to those in unit I-1. They are very deep and comparatively uniform throughout their profile. Slopes are very gentle. Runoff is slow to very slow, and internal drainage is medium to rapid.

The soils in this unit are—

(PbA) Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
(PeA) Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
(Tna) Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—Because of the slight concentrations of salts and alkali, these soils are not so well suited to agriculture as the soils in unit I-1. They are best suited to crops that will tolerate slight amounts of salts and alkali.

Some reclamation measures are advisable to eliminate the excess salts and alkali and increase the productivity of the soils. The amount of excess salts can be greatly reduced by deep leaching. Excess alkali can be corrected by the use of manure and gypsum. Irrigations should be

light, but frequent enough to keep the soil moist without causing a high water table.

Other management needs are the same as for the soils in unit I–1.

Capability unit IIs–7

Well-drained, moderately coarse textured to moderately fine textured, deep, moderately permeable to slowly permeable soils on low terraces

These soils are similar to the soils in unit I–1, but they are not so uniform in profile. Their subsoil contains more clay; the structure of the subsoil is more distinct; and the color of the soil is more reddish. The soils in unit I–1 are on the lower and more recent alluvial fan deposits, and the soils in this unit are on the higher, somewhat older alluvial fans and low terraces.

These soils are deep and well drained. They have almost no problems of drainage or of salts or alkali. The problem of erosion is slight.

The soils in this unit are—

(BeA) Borden fine sandy loam, 0 to 3 percent slopes.
(RsA) Ryer clay loam, 0 to 3 percent slopes.
(RsB) Ryer clay loam, 3 to 8 percent slopes.
(RtA) Ryer silt loam, 0 to 3 percent slopes.
(SnA) Snelling sandy loam, 0 to 3 percent slopes.
(SnB) Snelling sandy loam, 3 to 8 percent slopes.

Use and management.—These soils are moderately well suited to cultivation, but the choice of crops is more restricted than for the soils in unit I–1. Irrigated row crops, grain, and pasture plants are best suited. Some grapevines and deciduous fruit trees and nut trees are also grown, but they are less well suited.

The natural fertility of these soils is less than that of the soils in unit I–1. Legumes, both under irrigation and on dryland range, respond to phosphorus and sulfur. Plants other than legumes generally respond to nitrogen. Dryfarmed grain responds to phosphorus, or to phosphorus and small amounts of nitrogen. Grapevines and deciduous fruit and nut trees may show a need for zinc and possibly manganese.

The content of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues. Excessive cultivation may cause the formation of a plowsole and a consequent problem of slow infiltration of water.

Excessive irrigation should be avoided to prevent waterlogging and a perched water table. Leveling for irrigation is generally not difficult and in most places can be done with little damage to the soil.

Erosion is not a problem if reasonable care is used. On slopes of 3 to 8 percent, sprinkler irrigation and cross-slope cultivation are advisable to conserve soil and water. Crop residues should be disked into the soil to form a mulch.

Capability unit IIIe–1

Gently sloping to rolling, moderately coarse textured, deep, moderately permeable soils on older terraces

These soils are similar to those in unit IIe–1, but they are more strongly sloping and not quite so deep. They lie on the sloping and dissected parts of weakly consolidated, gritty, old terrace deposits.

These soils have no drainage problem and no problems of salts or alkali. The hazard of erosion is slight.

The soils in this unit are—

(SnB2) Snelling sandy loam, 3 to 8 percent slopes, eroded.
(WhB) Whitney fine sandy loam, 3 to 8 percent slopes.
(WhB2) Whitney fine sandy loam, 3 to 8 percent slopes, eroded.
(WkB) Whitney sandy loam, 3 to 8 percent slopes.
(WmB2) Whitney and Rocklin soils, 3 to 8 percent slopes, eroded.

Use and management.—These soils are moderately well suited to cultivation, but they are less well suited than the soils in unit IIe–1, because of their stronger slopes and dissected relief. They are used principally for dryfarmed grain and range. A variety of crops could be grown if irrigation water were available. The best suited crops would be irrigated grain, grapevines, and pasture, which need only a moderate rooting depth.

The natural fertility of these soils is moderate. The supply of organic matter and nitrogen is low. Dryfarmed grain responds best to phosphorus or to phosphorus and small amounts of nitrogen. Range plants would probably benefit most from the addition of nitrogen, phosphorus, and sulfur. Irrigated legumes would be most benefited by phosphorus and sulfur, and other irrigated crops would respond to nitrogen. The supplies of the minor elements are adequate. The content of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

Irrigation water should be applied carefully, on the contour or by sprinklers, to conserve both soil and water.

Erosion can be controlled by cross-slope cultivation if reasonable care is used. The surface should not be left bare of vegetation during the rainy season. Crop residues should be disked into the surface soil.

If used for range, these soils should be managed like those in unit VIe–4.

Capability unit IIIe–4

Well drained to somewhat excessively drained, level to gently sloping, coarse-textured, moderately deep to very deep, moderately permeable to rapidly permeable soils on flood plains and wind-modified alluvial fans

Most of these soils are similar to those in unit IIs–4, except that they are more droughty. Some of them are droughty because they are very deep and coarse textured throughout. Others are coarse textured but have slightly more clay in their subsoil or are underlain by an unrelated hardpan or silty substratum. The Columbia soils lie along streams on the flood plains. The other soils occur on wind-modified alluvial fans.

The soils in this unit are—

(AgA) Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes.
(AgB) Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes.
(AnA) Atwater sand, 0 to 3 percent slopes.
(AnB) Atwater sand, 3 to 8 percent slopes.
(CeA) Columbia soils, channeled, 0 to 3 percent slopes.
(DbA) Delhi loamy fine sand, 0 to 3 percent slopes.
(DbB) Delhi loamy fine sand, 3 to 8 percent slopes.
(DcA) Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes.
(DdA) Delhi loamy sand, 0 to 3 percent slopes.
(DdB) Delhi loamy sand, 3 to 8 percent slopes.
(DeA) Delhi loamy sand, silty substratum, 0 to 3 percent slopes.
(DgA) Delhi sand, silty substratum, 0 to 3 percent slopes.
(DgB) Delhi sand, silty substratum, 3 to 8 percent slopes.
(TtA) Tujunga loamy sand, 0 to 3 percent slopes.

Use and management.—In crop suitability and management needs, the very deep soils are similar to those of unit IIe–4. The moderately deep and deep soils are not suitable for orchards. It is more difficult to keep enough moisture in these soils. Organic matter should be added generously to increase the moisture-holding capacity. Green-manure crops, crop rotations, and crop residues will help maintain the supply of organic matter. Sprinkler irrigation is best, because very frequent, light applications of water are needed.

Large amounts of nitrogen, phosphorus, and sulfur are needed. Split applications are advisable, to decrease losses by leaching. Specialty crops, such as potatoes, may respond to potassium. Minor elements—zinc and possibly manganese—often bring a response from grapes and stone fruits.

Control of wind erosion is necessary to prevent the choking of roads and irrigation systems and the destruction of newly germinated crops. Winter cover crops are advisable. Crop residues worked down as a mulch will help control wind erosion.

Capability unit IIIw–2

Imperfectly drained to poorly drained, moderately coarse textured to moderately fine textured soils in the basin area and on alluvial fans; moderately deep to deep, moderately permeable to slowly permeable

These soils occupy low-lying areas and depressions in the basin, on the flood plains, and on the alluvial fans. They are frequently flooded. Because of the fluctuating high water table, there are slight concentrations of salts and alkali in some places.

The soils in this unit are—

(BaA) Bear Creek clay loam, 0 to 3 percent slopes.
(BcA) Bear Creek loam, 0 to 3 percent slopes.
(FaA) Foster fine sandy loam, 0 to 1 percent slopes.
(FdA) Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
(GeA) Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes.
(LcA) Landlow silt loam, 0 to 1 percent slopes.
(LeA) Landlow silty clay loam, 0 to 1 percent slopes.
(MmA) Merced clay loam, slightly saline, 0 to 1 percent slopes.
(SmA) Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes.
(TdA) Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes.

Use and management.—The best uses for these soils are row crops, grain, rice, and irrigated pasture. Deep-rooted crops, such as alfalfa and fruit and nut trees, are not suited.

These soils need drainage and flood control. The saline and alkali soils can be reclaimed by lowering the water table with drains or pumps and applying gypsum and organic matter, as suggested for unit IIs–6.

Other management needs are similar to those described for unit IIw–2.

Capability unit IIIw–4

Imperfectly drained, coarse-textured, moderately deep to very deep soils on wind-modified alluvial fans

These soils occur in depressions and low-lying areas. They have a fluctuating high water table for much of the year. The surface soil is sand or loamy sand. The Dello soils are sandy throughout. The Hilmar soils are underlain by lenses or substrata of silt. The Atwater soil has a slight accumulation of clay in the subsoil.

In many places these soils contain weak accumulations of salts at the upper surface of the moist zone in the profile. When the coarse-textured surface soil dries out, it is subject to severe wind erosion if it is not properly managed.

The soils in this unit are—

(AkA) Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes.
(DhA) Dello loamy fine sand, 0 to 1 percent slopes.
(DkA) Dello sand, 0 to 1 percent slopes.
(DoA) Dello sand, slightly saline-alkali, 0 to 1 percent slopes.
(HgA) Hilmar loamy sand, 0 to 3 percent slopes.
(HhA) Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes.
(HoA) Hilmar sand, 0 to 3 percent slopes.
(HpA) Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes.

Use and management.—Because of the high water table, these soils are suited only to pasture, grain, and row crops.

These soils can be improved by the use of drainage pumps or ditches, along with careful and frequent applications of small amounts of irrigation water. After drainage has been improved, the salts can be leached quickly from these rapidly permeable soils.

Leveling fills depressions with materials from higher areas. Where this happens, the salts in the buried soils generally prevent the growth of the deeper rooted permanent crops for a number of years. Dense growths of grasses or reeds should be removed before the soil is leveled.

Capability unit IIIw–5

Imperfectly drained and poorly drained, fine-textured, slowly permeable soils in the basin area and on old alluvial fans.

All of these soils have a fine-textured surface soil. The Merced and Landlow soils are deep. They contain accumulations of salts or alkali, but the effect is only slight.

The Alamo soil is shallow over hardpan. It lies in depressions on the terraces.

The soils in this unit are—

(AaA) Alamo clay, 0 to 1 percent slopes.
(LaA) Landlow clay, 0 to 1 percent slopes.
(LbA) Landlow clay, slightly saline-alkali, 0 to 1 percent slopes.
(MhA) Merced clay, slightly saline, 0 to 1 percent slopes.
(MkA) Merced clay, moderately saline, 0 to 1 percent slopes.

Use and management.—These soils are best suited to row crops, rice, grain, and irrigated pasture. Adequate drainage should be provided for all soils in this unit.

The supply of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues. Crops other than legumes are likely to respond to nitrogen. Legumes are likely to respond to phosphorus and sulfur.

The Alamo soil occurs in small depressions that stay too wet for cultivation long after the surrounding soils have drained. This interferes with the management of the surrounding soils, which are generally used for dry-farmed grain.

Irrigation water should be applied carefully, to prevent waterlogging or a perched water table.

Capability unit IIIw–6

Imperfectly drained and poorly drained, moderately coarse textured to moderately fine textured, deep, slightly to moderately saline-alkali soils in the basin area

These soils are similar to and associated with the soils in unit IIIw–2, but they are more strongly affected by salts, alkali, or both. Intensive reclamation and drainage practices are needed before cultivated crops can be grown.

The soils in this unit are—

(BmA) Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes.
(BrA) Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes.
(DsA) Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes.
(GdA) Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes.
(LdA) Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes.
(LfA) Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes.
(MnA) Merced clay loam, moderately saline, 0 to 1 percent slopes.
(PsA) Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes.
(RoA) Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are suited to irrigated pasture, grain, and row crops that will tolerate moderate concentrations of salts or alkali.

Adequate surface and subsurface drainage are needed. Subsurface drainage can be provided by open ditches or tile drains.

Heavy applications of manure and gypsum are necessary for reclamation. The content of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

Capability unit IIIs–5

Well-drained, nearly level to gently sloping, fine-textured, shallow to moderately deep, slowly permeable soils on terraces and low foothills

These are fine-textured soils on bedrock or soft sediments. All of them contain more or less free lime. Slopes are gentle. Drainage is good, and an excess of salts or alkali is not a problem. The hazard of erosion is slight.

The soils in this unit are—

(2HB) Hopeton clay, 0 to 8 percent slopes.
(PwA) Porterville clay, 0 to 3 percent slopes.
(PwB) Porterville clay, 3 to 8 percent slopes.
(RaA) Raynor clay, 0 to 3 percent slopes.
(RaB) Raynor clay, 3 to 8 percent slopes.
(SgA) Seville clay, 0 to 3 percent slopes.
(SgB) Seville clay, 3 to 8 percent slopes.

Use and management.—These soils are suited to dryfarmed grain, range, row crops, and irrigated pasture. The vegetation is grass.

Dryland range and pasture plants grow well without fertilizer, but they respond to nitrogen, phosphorus, and sulfur. Irrigated row crops benefit most from the addition of nitrogen. Dryfarmed grain benefits from the addition of phosphorus or from phosphorus and small amounts of nitrogen. The minor elements are not known to be deficient or excessive. The supply of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

These soils do not require frequent irrigation, because they have a high moisture-holding capacity. Leveling cuts should be shallow because of the restricted depth of the usable soil. Using sprinklers might eliminate most of the need for leveling.

Erosion control measures are comparatively simple because of the gentle slopes and natural stability of these soils. Cross-slope cultivation and winter cover crops will protect the soils that have slopes of 3 to 8 percent.

Capability unit IIIs–6

Well-drained, moderately coarse textured to moderately fine textured, deep, slightly to moderately saline-alkali soils on alluvial fans and flood plains

These soils are similar to those in unit IIs–6, except that their subsoil contains slight to moderate concentrations of salts and alkali and 25 to 70 percent of the surface soil is affected by salts and alkali.

The soils in this unit are—

(BfA) Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes.
(ThA) Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes.
(ToA) Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—Because of the slight to moderate concentrations of salts and alkali, these soils are less well suited to agriculture than the soils in unit IIs–6. Irrigated grain, row crops, and pasture plants that are shallow rooted and tolerant of salts and alkali are best suited. Other crops are likely to be much less productive and to show damage from the excess salts and alkali.

The measures needed to reclaim these soils are generally similar to those described for unit IIs–6. Larger amounts of water, manure, and gypsum are required, however, and improvement is slower.

The supply of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

Capability unit IIIs–8

Imperfectly drained, medium textured to moderately fine textured, shallow, slightly saline-alkali soils in the basin area

These soils occupy nearly level areas in the basin. They are slightly affected by salts and alkali. Salts and alkali are present in the subsoil, and they also affect up to 25 percent of the surface soil. These soils have a hardpan or claypan at a relatively shallow depth. This makes them more difficult to reclaim than the soils in unit IIIs–6.

Pozo clay loam, 0 to 1 percent slopes, is included in this unit because it is the only soil of its kind in this area. It is not affected by salts or alkali, but it is otherwise similar to the other soils in the unit.

The soils in this unit are—

(FfA) Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes.
(FpA) Fresno loam, slightly saline-alkali, 0 to 1 percent slopes.
(LkA) Lewis loam, slightly saline-alkali, 0 to 1 percent slopes.
(LoA) Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes.
(PyA) Pozo clay loam, slightly saline, 0 to 1 percent slopes.
(PxA) Pozo clay loam, 0 to 1 percent slopes.

Use and management.—These soils are suited to shallow-rooted, salt- and alkali-tolerant crops. Removing some of the salts and alkali from the surface soil generally improves stands and increases yields.

The fertility of these soils is moderate to low. The addition of phosphorus and sulfur usually benefits legumes. Other crops need nitrogen. There are no known deficiencies of minor elements. The supply of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

It is not possible to leach the salts and alkali out of the soil as long as the hardpan remains intact. All that can be done is to add manure and gypsum and to use water to move the excess salts and alkali as deep into the subsoil as possible. Results are better if the hardpan can be broken.

Considerable care is needed in irrigating these soils because their effective depth is restricted. Temporary waterlogging, a perched water table, and reduced aeration of the soil are constant hazards. Frequent, light irrigations are best.

Leveling these soils must be done very carefully. Even shallow cuts reduce the effective rooting zone, and deeper cuts expose the hardpan.

Capability unit IVe-1

Rolling, moderately coarse textured soils on older terraces and lower foothills; moderately deep to deep, slowly to moderately rapidly permeable

Except that their slopes are stronger and they are eroded in some places, these soils are similar to those in unit IIIe-1. The profiles tend to be slightly shallower, runoff is more rapid, and the hazard of erosion is greater. The Snelling soils are deep, but they are like the other soils of this unit in slope and in erosion hazard.

The soils in this unit are—

(SnC) Snelling sandy loam, 8 to 15 percent slopes.
(SnC2) Snelling sandy loam, 8 to 15 percent slopes, eroded.
(WhC) Whitney fine sandy loam, 8 to 15 percent slopes.
(WhC2) Whitney fine sandy loam, 8 to 15 percent slopes, eroded.
(WkC) Whitney sandy loam, 8 to 15 percent slopes.
(WkC2) Whitney sandy loam, 8 to 15 percent slopes, eroded.
(WmC2) Whitney and Rocklin soils, 8 to 15 percent slopes, eroded.

Use and management.—These soils are suited to dry-farmed grain, range, and irrigated pasture.

Irrigation is advisable only on close-growing crops and under very careful management. Sprinklers are probably the best method of irrigation.

Otherwise, these soils should be managed like those in unit IIIe-1. Cross-slope cultivation, stubble mulching, and crop residues should be used, to control erosion. When these soils are dry-farmed, they should be in grass cover 75 percent of the time. The content of organic matter can be maintained by the use of crop rotations and crop residues.

When used for range, these soils should be managed like those of unit VIe-4.

Capability unit IVe-3

Rolling, moderately coarse textured to moderately fine textured, predominantly shallow, slowly permeable soils on older, more dissected alluvial fans and terraces

Shallow profiles restrict the effective rooting depth and limit the moisture-holding capacity of these soils. The erosion hazard is slight to moderate.

The soils in this unit are—

(CgB) Corning gravelly loam, 0 to 8 percent slopes.
(CkB) Corning gravelly sandy loam, 0 to 8 percent slopes.
(GfB3) Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied.
(3HB) Hopeton clay loam, 3 to 8 percent slopes.
(3HC) Hopeton clay loam, 8 to 15 percent slopes.
(4HB) Hopeton gravelly clay loam, 0 to 8 percent slopes.
(KaB) Keyes gravelly clay loam, 0 to 8 percent slopes.
(KbB) Keyes gravelly loam, 0 to 8 percent slopes.
(MdB) Madera sandy loam, 3 to 8 percent slopes.
(MrB) Montpellier coarse sandy loam, 3 to 8 percent slopes.
(MrC) Montpellier coarse sandy loam, 8 to 15 percent slopes.
(ReB) Redding gravelly loam, 0 to 8 percent slopes.
(RgB) Rocklin loam, 3 to 8 percent slopes.
(RgC) Rocklin loam, 8 to 15 percent slopes.
(RkB) Rocklin sandy loam, 3 to 8 percent slopes.
(RkB2) Rocklin sandy loam, 3 to 8 percent slopes, eroded.
(SbB) San Joaquin loam, 3 to 8 percent slopes.
(ScB) San Joaquin sandy loam, 3 to 8 percent slopes.
(YcB) Yokohl loam, 3 to 8 percent slopes.

Use and management.—These soils are best suited to dryfarmed grain, irrigated pasture, and range. Sprinkling is the best method of irrigating.

These soils need the same fertilizers and respond to them in about the same way as the soils in unit IVs-3. Yields are generally about the same or slightly less.

If these soils are kept under permanent cover, few or no special practices are necessary to control erosion. If they are cultivated, cross-slope farming and stubble mulching will help protect them from erosion. The content of organic matter can be maintained by use of crop rotations and crop residues.

When used for range, these soils should be managed in the same way as those of unit VIe-9.

Capability unit IVe-4

Excessively drained, coarse-textured, very deep, very rapidly permeable soils and miscellaneous land types on flood plains and wind-modified alluvial fans

These soils and land types are sandy and gravelly. Their moisture-holding capacity is very low.

The soils and miscellaneous land types in this unit are—

(DfA) Delhi sand, 0 to 3 percent slopes.
(DfB) Delhi sand, 3 to 8 percent slopes.
(DfC) Delhi sand, 8 to 15 percent slopes.
(DuA) Dune land, 0 to 3 percent slopes.
(DuB) Dune land, 3 to 8 percent slopes.
(TsA) Tujunga gravelly sand, channeled, 0 to 8 percent slopes.
(TuA) Tujunga sand, 0 to 3 percent slopes.
(TwA) Tujunga sand, channeled, 0 to 8 percent slopes.

Use and management.—These soils are best suited to deep-rooted crops, such as alfalfa, orchard fruits and nuts, and grapes.

Management needs are similar to those of the soils in unit IIIe-4, except that more frequent and lighter applications of water are needed. Unless the slopes can be leveled to less than 1 percent, *only* sprinklers should be

used for irrigation. Surface irrigation can result in severe erosion. It requires large heads of water, because the soil absorbs water so fast.

Capability unit IVe-5

Well-drained, sloping to hilly, fine-textured, shallow and moderately deep soils on old terraces and uplands

These soils are similar to those in unit IIIs-5, except that they are steeper and runoff and erosion hazard are greater.

The soils in this unit are—

(PnB) Peters clay, 0 to 8 percent slopes.
(PnC) Peters clay, 8 to 15 percent slopes.
(RaC) Raynor clay, 8 to 15 percent slopes.
(YaA) Yokohl clay, 0 to 3 percent slopes.

Use and management.—These soils are not so well suited to cultivation as the soils of unit IIIs-5. They are best suited to dryfarmed grain, range, and irrigated pasture.

Water is generally not available to irrigate these soils, but where it is, the best crop is irrigated pasture. Sprinkling is the best method of irrigation.

Management needs are similar to those of the soils in unit IIIs-5. Irrigation should be carefully managed to prevent erosion. These soils are stable, and the erosion hazard is slight when dryfarmed grain or range is grown. Cross-slope farming and the use of crop residues as a mulch will help control erosion.

Capability unit IVw-4

Poorly drained, coarse-textured, moderately deep to very deep soils on wind-modified alluvial fans

These soils occur in poorly drained depressions in the windblown sands near Delhi. They are similar to the soils in unit IIIw-4, except that they are poorly drained. Water often stands at or near the surface.

The soils in this unit are—

(AdA) Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes.
(DmA) Dello sand, poorly drained, 0 to 1 percent slopes.
(DnA) Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes.
(HfA) Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes.
(HkA) Hilmar sand, poorly drained, 0 to 1 percent slopes.

Use and management.—These soils are best suited to shallow-rooted crops, such as grain and irrigated pasture.

The management of these soils is similar to that of the soils in unit IIIw-4 in most respects. The hazard of wind erosion is not important unless the soils are drained and cultivated.

These soils should be drained with pumps and tile systems, and the depressions should be filled and leveled before crops are planted. It is difficult to drain these soils because they are in depressions.

Crop rotations and crop residues should be used to maintain the content of organic matter.

Capability unit IVw-6

Imperfectly drained to poorly drained, moderately coarse textured to moderately fine textured soils in the basin area; moderately deep, moderately to strongly saline-alkali

Except for moderate to strong concentrations of salts and alkali, these soils are similar to those in unit IIIw-6. The salts and alkali are present throughout the subsoil, and in addition they affect the surface soil over more than 25 percent of the area.

The soils in this unit are—

(DtA) Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes.
(PtA) Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes.
(RpA) Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are best suited to grain and irrigated pasture. Only crops that can tolerate moderate to strong concentrations of salts and alkali should be planted. Reclamation measures are similar to those needed for the soils in unit IIIw-6, but larger amounts of water, manure, and gypsum are needed, and improvement is slower.

Capability unit IVs-3

Well-drained, level to gently sloping, moderately coarse textured to moderately fine textured, shallow, very slowly permeable soils on terraces and uplands

These soils are shallow and have both a hardpan and claypan. The pans limit the effective rooting depth and the moisture-holding capacity. Internal drainage is very slow.

Slopes are fairly regular in most places, but in others, especially on the San Joaquin soils, they are conspicuously undulating, mounded, or hogwallowed.

These soils have slower runoff and less hazard of erosion than the soils in unit IVe-3.

Included are small tracts of slightly saline-alkali Madera loam.

The soils in this unit are—

(3HA) Hopeton clay loam, 0 to 3 percent slopes.
(MaA) Madera fine sandy loam, 0 to 3 percent slopes.
(MbA) Madera loam, 0 to 1 percent slopes.
(McA) Madera loam, slightly saline-alkali, 0 to 1 percent slopes.
(MdA) Madera sandy loam, 0 to 3 percent slopes.
(MrA) Montpellier coarse sandy loam, 0 to 3 percent slopes.
(RgA) Rocklin loam, 0 to 3 percent slopes.
(RkA) Rocklin sandy loam, 0 to 3 percent slopes.
(SbA) San Joaquin loam, 0 to 3 percent slopes.
(ScA) San Joaquin sandy loam, 0 to 3 percent slopes.
(SdA) San Joaquin-Alamo complex, 0 to 3 percent slopes
(YbA) Yokohl clay loam, 0 to 3 percent slopes.
(YcA) Yokohl loam, 0 to 3 percent slopes.

Use and management.—The soils in this unit are used for a variety of dryfarmed and irrigated crops and range. If irrigated, they are suited to the more shallow-rooted row crops, grain, and pasture; if unirrigated, they are best suited to dryfarmed grain and range. They are not suited to the deeper rooted irrigated crops because the rooting depth is restricted.

These soils are low in fertility. They are especially deficient in nitrogen and phosphorus and may be deficient in lime. Dryfarmed grain and range are most likely to respond to nitrogen. Dryfarmed legumes respond to phosphorus and sulfur. Irrigated legumes benefit most from phosphorus and sulfur, and other irrigated crops from nitrogen. The supply of organic matter can be maintained by the use of green-manure crops, crop rotations, and crop residues.

If these soils are irrigated, careful practices are needed to prevent waterlogging, a temporary perched water table,

and reduced aeration. Frequent, light irrigations are advisable because of the low water-holding capacity. Sprinkler irrigation is probably best, especially where the relief is irregular.

Leveling cuts should be shallow because of the already restricted rooting depth. If sprinklers are used, there is little need for leveling, except to smooth off some of the mounds and fill some of the depressions.

In many places, attempts have been made to break or destroy the hardpan. The hardpan has been blasted where orchards were being established. Most of these practices are costly and do little good because the substratum below the hardpan is partly consolidated.

Controlling erosion is comparatively simple because the slopes are gentle. Cross-slope cultivation, mulching, and the use of crop residues should be sufficient.

Capability unit IVs-6

Well-drained, moderately coarse textured to moderately fine textured, deep, moderately to strongly saline-alkali soils in the basin area

These soils are like those in unit IIIs-6, except that they contain moderate to strong concentrations of salts and alkali.

The soils in this unit are—

(TkA) Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes.
(TmA) Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes.
(TpA) Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are best suited to grain and irrigated pasture. They are used for range, but the forage is scant.

Reclamation of these soils requires large amounts of gypsum or sulfur and manure and prolonged leaching with large quantities of water. The water used for leaching must be drained away. After reclamation, these soils can be used for crops that are tolerant of strong concentrations of salts and alkali, such as pasture and Mariot barley.

Organic matter should be added to these soils in the form of manure, green-manure crops, and crop residues.

Capability unit IVs-8

Imperfectly drained, moderately coarse textured to moderately fine textured, shallow, slightly to moderately saline-alkali soils in the basin area

These soils are like those of unit IIIs-8, except that they contain slight to moderate concentrations of salts and alkali. The excess salts and alkali are present throughout the subsoil, and in addition they affect up to 70 percent of the surface area.

The soils in this unit are—

(FgA) Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes.
(FrA) Fresno loam, moderately saline-alkali, 0 to 1 percent slopes.
(LgA) Lewis clay, slightly saline-alkali, 0 to 1 percent slopes.
(LmA) Lewis loam, moderately saline-alkali, 0 to 1 percent slopes.
(LpA) Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes.
(PzA) Pozo clay loam, moderately saline, 0 to 1 percent slopes.
(WaA) Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes.
(WbA) Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.
(WdA) Waukena loam, slightly saline-alkali, 0 to 1 percent slopes.
(WeA) Waukena loam, moderately saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are less suitable for agriculture than the soils in unit IIIs-8 because they contain stronger concentrations of salts and alkali. They are best suited to shallow-rooted crops that are tolerant of salts and alkali, such as pasture, grain, or rice.

Measures to reclaim these soils are generally similar to those for the soils of unit IIIs-8, but more time and larger amounts of manure, gypsum, and water are usually required for improvement.

Capability unit VIe-4

Moderately steep, moderately deep, moderately coarse textured to medium textured soils on older terraces and lower foothills

Except for stronger slopes, these soils are similar to those in unit IVe-1. They have a severe hazard of erosion unless adequate protective cover is provided. They are moderately productive.

The soils in this unit are—

(SfB) Sesame rocky loam, 3 to 8 percent slopes.
(SfD) Sesame rocky loam, 8 to 30 percent slopes.
(SnD2) Snelling sandy loam, 15 to 30 percent slopes, eroded.
(WhD2) Whitney fine sandy loam, 15 to 30 percent slopes, eroded.
(WkD2) Whitney sandy loam, 15 to 30 percent slopes, eroded.

Use and management.—These soils are best suited to grazing. Proper stocking is the most important practice. The plants should be at least 4 inches high before they are grazed in the spring. If range has been properly grazed, the vegetation has a patchy appearance at the end of the grazing season. The stubble should average about 2 inches in height.

Range reseeding is often desirable where forage has been depleted by overgrazing or cultivation or where land has recently been cleared of brush and scrub trees. Suitable annual grasses and legumes should be planted.

These soils are suitable for fertilization. Fertilizers will increase the quantity and quality of forage and lengthen the grazing season. Grasses respond to nitrogen, and legumes respond to phosphorus and sulfur.

Cross fencing is necessary to obtain proper distribution of livestock and use of forage. Adequate watering places should be provided over the range, and salt should be so placed as to improve distribution of grazing.

The condition of the range is an indication of proper stocking, which is essential to good range management. When the site is producing at maximum, about 70 percent of the plant cover consists of desirable plants, such as soft chess, wild oats, burclover, alfileria, and small remnants of perennial grasses; 20 percent is less desirable plants, such as ripgut grass, annual fescue, annual bluegrass, mouse barley, and lupine; and 10 percent is undesirable plants, such as nitgrass, fiddleneck, and popcorn flower. Vegetation covers 55 to 70 percent of the ground surface. Active erosion is slight to nonexistent. Litter and residue are abundant, and partly decomposed vege-

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tation lies on the ground. Some plants are untouched or only partly grazed.

Capability unit VIe-5

Gently sloping to hilly, cobbly, fine-textured, slowly permeable soils on foothills

The soils in this unit are well drained. Runoff is medium to rapid, and the hazard of erosion is slight. The water-holding capacity and inherent fertility are moderate.

The soils in this unit are—

(PoB)	Peters cobbly clay, 0 to 8 percent slopes.
(PoD)	Peters cobbly clay, 8 to 30 percent slopes.
(RbA)	Raynor cobbly clay, 0 to 3 percent slopes.
(RbB)	Raynor cobbly clay, 3 to 8 percent slopes.
(RbC)	Raynor cobbly clay, 8 to 15 percent slopes.

Use and management.—These soils are best suited to grazing. Some areas are suitable for fertilization and reseeding with grasses and legumes.

Proper stocking is essential for maximum production and erosion control. Livestock should be kept off the range in spring until the grass is at least 4 inches high. An average of 2 inches of stubble should be left at the end of the grazing period. If the range has been properly grazed, the vegetation has a patchy appearance. Adequate water should be provided, and salt should be placed so as to improve distribution of livestock. Cross fencing is essential to obtain proper use of forage.

The condition of the annual grasses shows whether the range has been well managed. When the range is producing at maximum, about 70 percent of the plant cover is desirable plants, such as soft chess, wild oats, burclover, alfileria, and small amounts of perennial grasses; about 20 percent is less desirable plants, such as ripgut grass, foxtail barley, annual bluegrass, and lupine; and about 10 percent is undesirable plants, such as nitgrass, fiddleneck, tarweed, and popcorn flower. The vegetation covers 60 to 75 percent of the soil surface. There is little or no evidence of erosion. Litter and residue are abundant, and there is partly decomposed vegetation on the ground. Untouched or partly grazed plants are evident. The range has a patchy appearance at the end of the grazing season.

Capability unit VIe-9

Rolling to hilly, moderately coarse to medium textured, shallow, slowly permeable, infertile soils on dissected terraces

These soils are underlain by a claypan or hardpan at a depth of less than 20 inches. Runoff is medium to rapid. The soils are well drained. The hazard of erosion is moderate to severe, depending on the slope.

The soils, for the most part, are stony, cobbly, or gravelly. The moisture-holding capacity is low. Fertility is low, and the productivity is low. Some very acid soils on the high terraces south of the Merced River at Merced Falls are very low in productivity.

The soils in this unit are—

(CfB)	Corning cobbly loam, 3 to 8 percent slopes.
(CfD)	Corning cobbly loam, 8 to 30 percent slopes.
(CgD)	Corning gravelly loam, 8 to 30 percent slopes.
(CgD2)	Corning gravelly loam, 8 to 30 percent slopes, eroded.
(CkD)	Corning gravelly sandy loam, 8 to 30 percent slopes.
(CkD2)	Corning gravelly sandy loam, 8 to 30 percent slopes, eroded.
(KbC)	Keyes gravelly loam, 8 to 15 percent slopes.
(KcB)	Keyes-Pentz gravelly loams, 0 to 8 percent slopes.
(MrC2)	Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded.
(MrD2)	Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded.
(RcB)	Redding cobbly loam, 0 to 8 percent slopes.
(RdA)	Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes.
(ReD)	Redding gravelly loam, 8 to 30 percent slopes.
(RkC2)	Rocklin sandy loam, 8 to 15 percent slopes, eroded.

Use and management.—These soils are best suited to grazing. Proper range use is essential for maximum production and erosion control. Proper stocking is most important. The plants should be at least 4 inches high before they are grazed, and the stubble should average about 2 inches in height at the end of the grazing season. Adequate watering places should be provided over the range, and salt should be placed to improve distribution of grazing.

Where the average rainfall is more than 12 inches, the soils are suitable for fertilization and reseeding to annual grasses and legumes. The very acid soils south of the Merced River are not suitable for these practices. Grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Fertilizers will increase the quantity and quality of forage and lengthen the grazing season.

The condition of the range is an indication of proper stocking, which is essential to good range management. When the site is producing at maximum, about 70 percent of the plant cover consists of desirable plants, such as soft chess, wild oats, alfileria, annual clovers, annual trefoil, small amounts of burclover, and remnants of perennial grasses; about 20 percent is less desirable plants, such as ripgut grass, red brome, annual fescue, mouse barley, and annual lupine; and about 10 percent is undesirable plants, such as nitgrass, fiddleneck, tarweed, and larkspur. The vegetation covers 45 to 55 percent of the surface. Little or no active erosion is evident. Litter and residue are abundant, and there is partly decomposed vegetation on the ground. Untouched or partly grazed plants give the range a patchy appearance at the end of the grazing season.

Capability unit VIw-4

Poorly drained, coarse-textured, moderately deep, moderately to strongly saline-alkali soils in depressions

These are mottled, strongly alkaline sandy soils that have a water table at or near the surface much of the year. They are similar to the soils in unit IVw-4, except that they contain more salts and alkali. Most areas support a poor growth of saltgrass and sedges, and some areas have a surface of barren salt puffs.

The soils in this unit are—

(HmA)	Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes.
(HnA)	Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are used only for saltgrass pasture. This is their only use unless they are reclaimed. They produce little forage.

If the drainage is improved with drainage pumps, the salts and alkali can be leached out.

Capability unit VIw–6

Poorly drained and very poorly drained, moderately coarse textured to fine textured, moderately rapidly to slowly permeable, slightly to strongly saline-alkali soils in the basin area

These are poorly drained soils that contain slight to strong concentrations of salts and alkali.

The soils in this unit are—

(FbA) Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes.
(FcA) Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes.
(FeA) Foster gravelly fine sandy loam, 0 to 1 percent slopes.
(MoA) Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes.
(PuA) Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes.
(RmA) Rossi clay, moderately saline-alkali, 0 to 1 percent slopes.
(RnA) Rossi clay, strongly saline-alkali, 0 to 1 percent slopes.
(RrA) Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are so poorly drained or so much affected by salts and alkali that they are best suited to saltgrass or saline-alkali tolerant improved pasture.

Capability unit VIs–8

Imperfectly drained to poorly drained, moderately coarse textured to fine textured, shallow, moderately and strongly saline-alkali soils in the basin area

These soils are similar to the soils in unit IVs–8, except that they contain moderate to strong concentrations of salts and alkali. The salts and alkali are present throughout the subsoil. The surface soil is affected by salts and alkali in 25 percent or more of the area. The vegetation is meager, and in large areas there is almost none.

The soils in this unit are—

(FkA) Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes.
(FsA) Fresno loam, strongly saline-alkali, 0 to 1 percent slopes.
(FmA) Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes.
(FnA) Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes.
(FoA) Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes.
(LhA) Lewis clay, moderately saline-alkali, 0 to 1 percent slopes.
(LnA) Lewis loam, strongly saline-alkali, 0 to 1 percent slopes.
(LrA) Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes.
(WcA) Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes.
(WfA) Waukena loam, strongly saline-alkali, 0 to 1 percent slopes.

Use and management.—These soils are not suited to cultivated crops. Their best use is saltgrass pasture. If reclamation is attempted, rice or pasture may be planted on a trial basis.

Capability unit VIIe–3

Rolling to hilly, medium textured to moderately fine textured, shallow, moderately permeable soils on foothills

These soils are typically less than 20 inches deep over bedrock. Runoff is slow to rapid. The hazard of erosion is slight to moderate, depending on the slope. The soils are low in fertility and moisture-holding capacity, but they are moderate in productivity.

The soils in this unit are—

(AcA) Anderson gravelly soils, channeled, 0 to 3 percent slopes.
(ArB) Auburn rocky silt loam, 3 to 8 percent slopes.
(BdA) Bear Creek soils, 0 to 3 percent slopes.
(DaB) Daulton rocky silt loam, 3 to 8 percent slopes.
(DaD2) Daulton rocky silt loam, 8 to 30 percent slopes, eroded.
(EaD) Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes.
(PhB) Pentz clay loam, 0 to 8 percent slopes.
(PhD) Pentz clay loam, 8 to 30 percent slopes.
(PkB) Pentz gravelly loam, 0 to 8 percent slopes.
(PkD) Pentz gravelly loam, 8 to 30 percent slopes.
(PmB) Pentz loam, 0 to 8 percent slopes.
(PmD) Pentz loam, 8 to 30 percent slopes.
(PmE) Pentz loam, 30 to 75 percent slopes.
(WgB) Whiterock rocky silt loam, 3 to 8 percent slopes.
(WgB2) Whiterock rocky silt loam, 3 to 8 percent slopes, eroded.
(WgD) Whiterock rocky silt loam, 8 to 30 percent slopes.
(WgD2) Whiterock rocky silt loam, 8 to 30 percent slopes, eroded.

Use and management.—These soils are best suited to grazing. Proper stocking is most important. Livestock should be kept off the range early in spring until the grasses are 4 inches or more in height. An average of 2 inches of stubble should be left at the end of the grazing period. Adequate water should be provided over the range, and salt should be placed so as to improve distribution of livestock.

These soils are not suitable for reseeding or fertilization. Cross fencing is needed to obtain proper distribution of livestock and use of forage. Brush removal on some sites will increase production and improve plant cover.

When the range is producing at maximum, about 70 percent of the plant cover consists of desirable plants, such as soft chess, wild oats, burclover, alfileria, and remnants of perennial grasses; about 20 percent is less desirable plants, such as ripgut grass, annual fescue, bluegrass, lupine, and mouse barley; and about 10 percent is undesirable plants, such as nitgrass, fiddleneck, tarweed, and popcorn flower. The vegetation covers about 60 to 75 percent of the surface. Little or no erosion is active. Litter and residue are abundant, and decomposed vegetation lies on the ground. Untouched or partly grazed plants give the range a patchy appearance at the end of the grazing season.

Capability unit VIIe–9

Well drained to excessively drained, undulating to steep, moderately coarse textured and medium textured, very shallow to shallow soils on uplands and dissected old alluvial fans

These soils are on the more shallow, rolling to steep areas on uplands and steep terrace breaks. They are similar to those in unit VIe–9, except that they have shallower depths, lower fertility, or steeper slopes. Rock outcrops, gravel, or cobblestones are common. Runoff is medium to rapid. Internal drainage is medium to slow. The water-holding capacity is low. The productivity is very low. The hazard of erosion is severe, unless adequate vegetation covers the soil.

The soils in this unit are—

- (AbB) Amador loam, 0 to 8 percent slopes.
- (AbD) Amador loam, 8 to 30 percent slopes.
- (AbE) Amador loam, 30 to 45 percent slopes.
- (CgE2) Corning gravelly loam, 30 to 45 percent slopes, eroded.
- (CkE2) Corning gravelly sandy loam, 30 to 45 percent slopes, eroded.
- (5HB) Hornitos fine sandy loam, 3 to 8 percent slopes.
- (5HD) Hornitos fine sandy loam, 8 to 30 percent slopes.
- (5HE) Hornitos fine sandy loam, 30 to 45 percent slopes.
- (6HB) Hornitos gravelly fine sandy loam, 0 to 8 percent slopes.
- (6HD) Hornitos gravelly fine sandy loam, 8 to 30 percent slopes.
- (MrE2) Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded.
- (WhE2) Whitney fine sandy loam, 30 to 45 percent slopes, eroded.

Use and management.—These soils are suited only to grazing. Yields are very low because of droughtiness, shallowness, and low fertility. The grazing management practices discussed under capability unit VIe-9 apply to these soils, except that reseeding and fertilization are not feasible.

When the site is producing at maximum, about 60 percent of the cover consists of desirable plants, such as soft chess, annual clovers, and alfileria; about 25 percent is less desirable plants, such as ripgut grass, red brome, annual fescue, mouse barley, and annual lupine; and about 15 percent is undesirable plants, such as fiddleneck, popcorn flower, goldfields, and owlclover. The vegetation covers only 25 to 40 percent of the ground surface. There is little or no active erosion. Litter and residue are adequate, and partly decomposed vegetation lies on the ground. Untouched or partly grazed plants give the range a lightly grazed appearance at the end of the grazing season.

Capability unit VIIIs-1

Miscellaneous land types, nonagricultural

This unit contains miscellaneous land types that have no agricultural value. Their characteristics vary considerably.

The land types in this unit are—

- (Pv) Pits.
- (Rf) Riverwash.
- (Sa) Sandstone rock land.
- (Se) Schist rock land.
- (Sh) Slate rock land.
- (Ta) Tailings.
- (Tg) Terrace escarpments.
- (Tr) Tuff rock land.

Use and management.—These land types are suitable for wildlife shelter, for watersheds, and for recreation areas. Tailings are sometimes used as a source of road gravel. Sand and gravel for concrete are obtained from Riverwash. Sandstone rock land is quarried for building stone, and Slate rock land is quarried for roofing slate.

Formation and Classification of Soils

The soils of the Merced Area differ in fertility, physical and chemical properties, and productivity. These differences are the result of local differences in the environments under which the soils have formed.

Formation of Soils of the Area

Soil is the product of the forces of weathering and soil development acting on the parent soil material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief or lay of the land; and (5) the length of time the forces of development have acted on the material (*9, 12*). The influence of climate on soil and plants depends not only on temperature, rainfall, and humidity, but also on the physical characteristics of the soil or soil material and on the relief, which in turn strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Parent material

The parent materials from which the soils of the Area have developed are of three kinds: alluvium, weakly consolidated secondary rocks, and hard bedrock.

The largest areas of soils are found on alluvial parent materials washed from the Sierra Nevada since the early Pleistocene or late Pliocene epochs. These materials range in character from clayey deposits in the lower basin areas, through broad expanses of sandy deposits on fans, to poorly sorted mixed gravel on fans.

The alluvial materials can also be grouped into several kinds, based upon the source rock. The dominant alluvium is that derived from granitic rocks and laid down by major streams that drain the higher parts of the Sierra Nevada. The larger of the minor streams drain areas made up mainly of basic igneous rocks, such as meta-andesite, with some mixture of granitic rocks and metasediments (*27*). The smaller of the minor streams drain exclusively areas of metasediments, principally Mariposa slate and metasandstone. The very old, gravelly, mixed alluvium of the Redding soils was derived from a wide variety of igneous and metamorphic rocks.

The weakly consolidated secondary rocks that occupy about a tenth of the Area are of two types: sandstone and water-laid volcanic tuff.

The hard bedrock is of limited extent. It consists of a narrow fringe of the foothills made up of slate, metasandstone, and metavolcanic rocks, with a few spots of granitic intrusions.

The distribution of the parent materials of the various soils is shown in figure 16. This map was compiled from soil information, topographic studies, and purely geological investigations. The various types of parent materials are described below.

Recent alluvium.—This parent material consists of relatively unweathered sediments on flood plains and on younger alluvial fans. At times it is flooded, and occasionally it receives deposits of new material. It has developed into Anderson, Columbia, Grangeville, Hanford, Honcut, Tujunga, and Yolo soils.

Young alluvium.—These sediments are older than those described as Recent alluvium, but they were deposited in recent or late glacial geologic time. They are a part of

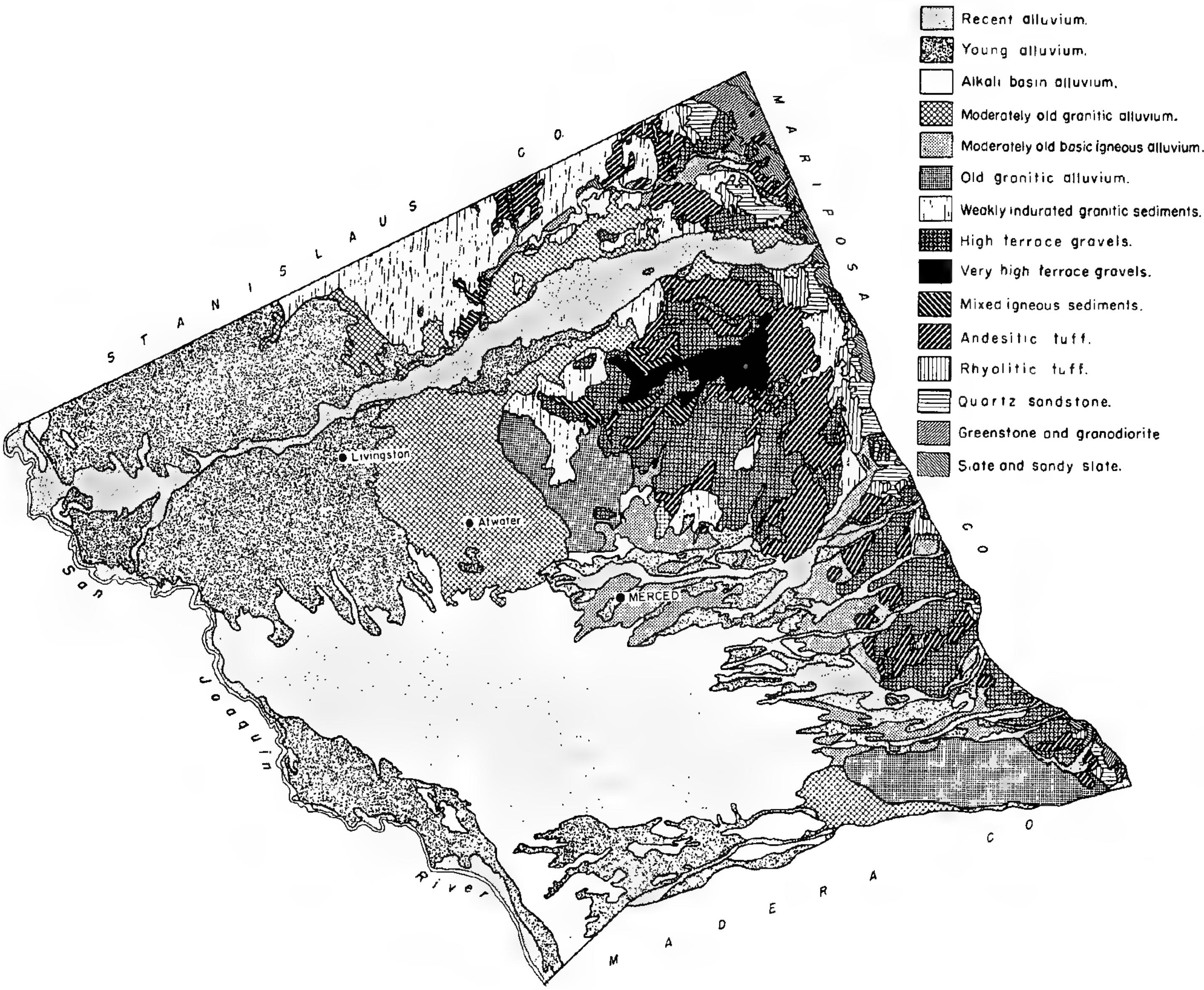

Figure 16.—**Parent materials of the soils in the Merced Area.**

the Modesto formation.[9] They are flooded less frequently than the Recent alluvium, and new material is deposited more slowly. Some areas have no flooding and receive no new deposits of material. A large area in the northwestern part of the Merced Area has stratified sandy and silty sediments that appear to have been deposited partly in shallow lake waters, probably during a very late stage in the glacial history of the Sierra Nevada.

This parent material has been slightly to moderately weathered. Soil profiles are fairly distinct. These materials have developed into the Bear Creek, Delhi, Dello, Dinuba, Hilmar, Marguerite, Merced, Pachappa, Piper, Temple, and Wyman soils.

Alkali basin alluvium.—The sediments in the saline-alkali basin are probably of the same origin and age as the materials described as young alluvium. However, they have been modified by the high water table that has affected the entire basin area since the time this material was deposited.

Most of these sediments have developed into the Burchell, Landlow, Lewis, Pozo, Rossi, and Waukena soils. The Fresno and Traver soils developed from sandy alluvium that seems to have been deposited partly in shallow lakebeds.

Moderately old granitic alluvium.—This material ranges in texture from medium sand to silt. It is of granitic origin, is stratified, and is fairly well sorted. It lies on terraces and alluvial fans, which are probably related to a late or middle stage in the glacial history of the Sierras. These terraces and fans lie on two levels or planes; the difference in elevation is about 40 feet. This

[9] DAVIS, STANLEY N., and HALL, F. A. WATER QUALITY OF EASTERN STANISLAUS AND NORTHERN MERCED COUNTIES, CALIFORNIA. Stanford Univ. Pub. Geol. Sci. VI(1) : 112 pp., illus.

parent material dates from the Pleistocene epoch and is part of the Riverbank geologic formation.[10]

This alluvium has developed into the Atwater, Borden, Greenfield, and Snelling soils and part of the Madera soils. These soils are strongly weathered. They have a distinct clayey subsoil, a cemented hardpan, or both.

Moderately old basic igneous alluvium.—These sediments were laid down by local streams. They are similar to the sediments of the Riverbank geologic formation and date from the Pleistocene epoch.[10] The Porterville, Ryer, Seville, and Yokohl soils have developed from this parent material. They are moderately to strongly weathered. Most of them have cemented or calcareous subsoils.

Old granitic alluvium.—This material formed on terraces and alluvial fans. It is purely granitic in origin and is also part of the Riverbank formation.[10] It is possibly related to a middle stage in the glaciation of the Sierra Nevada.

The Alamo and San Joaquin soils, and, in part, the Madera soils developed from this material. They are reddish in color, are more strongly weathered than the soils derived from moderately old granitic alluvium, and have a strongly cemented hardpan. On the bank of the Chowchilla River, west of the Santa Fe tracks, a soil profile of the San Joaquin series has been buried by moderately old alluvium, which has since developed into a profile of Madera soil.

Weakly indurated granitic sediments.—This material consists of weakly consolidated granitic sandstones of the Turlock Lake geologic formation.[10] It lies on a high, considerably dissected old alluvial fan north of the Merced River. It is the oldest of the sandy deposits in the Area. Presumably, it is related to an early stage of glaciation in the Sierra Nevada.

The sediments that made up the sandstone were sorted. The lower part of the material consists mostly of fine sand and very fine sand. A bed of very coarse sand was deposited above the finer material, but much of the coarser material has been stripped away by erosion. The Montpellier, Rocklin, and Whitney soils and part of the Corning soils developed from this sandstone.

High terrace gravels.—This material consists of poorly sorted gravel, cobblestones, and finer material that lie on remnants of broad high terraces in the northeastern part of the county. This gravel is generally underlain by andesitic tuff. In many places erosion has removed the gravel and cut into the tuff, and between these places the gravel has been left as a capping over the tuff beds. This terrace gravel apparently corresponds to the Arroyo Seco gravel of the Mokelumne Area (*19*). It was probably laid down during the early Pleistocene mountain-building period in the Sierra Nevada.

This material has developed into the Keyes soils and, in part, into the Corning and Redding soils.

Very high terrace gravels.—These gravels are on remnants of high terraces. The elevation is about 600 feet, but if a line along the surface were projected into the foothills, it would reach the foothills at an elevation of more than 1,000 feet. This height is about the same as or a little less than that of the Eocene rocks of the mountains. These terraces may have formed during the Pliocene mountain valley stage described by Matthes (*14*).

Part of the Redding soils, which are the most strongly weathered soils in California, have developed from these mixed gravels. The material is leached and strongly acid to a depth of 40 feet or more.

Mixed igneous sediments.—This material is micaceous and may be a mixture of granitic and tuffaceous sediments. It occurs in the same position as the Laguna geologic formation ascribed to the Pliocene epoch (*19*). Stratigraphically it lies beneath the mixed gravel on the very high terraces.

This material has developed into soils similar to those derived from andesitic tuff. Part of the Hopeton, Pentz, and Whitney soils have developed from it.

Andesitic tuff.—This material is the Mehrten geologic formation (*19*). It originated as volcanic eruptions high in the Sierra Nevada during the late Miocene and early Pliocene epochs. The Peters and Raynor soils and part of the Hopeton and Pentz soils developed from this material.

Rhyolitic tuff.—This parent material was identified near Merced Falls as the Valley Springs formation of middle Miocene age (*1*, *19*). It developed into the strongly acid, infertile Amador soils. These soils are generally white to pale yellow, and the surface has a distinctive microrelief of mounds.

Quartz sandstone.—This parent material ranges from very hard, white, yellow, or red mottled sandstone to yellow, soft, loose sand. It is the upper part of the Ione formation of Eocene age (*1*). The Hornitos soils have developed from this parent material. The clay beds that are commonly part of the Ione formation were not observed in the Merced Area.

Greenstone and granodiorite.—These parent materials occur along the Mariposa County line. Greenstone is a general term used for a bedrock complex of low-grade, metamorphosed, basic, igneous rocks and greenstone schists of Jurassic age. The granodiorite is an intrusive igneous rock. The Auburn, Exchequer, and Sesame soils developed from material weathered from these rocks.

Slate and sandy slate.—These slate rocks are all presumed to belong to the Mariposa complex of Jurassic age. The Daulton and Whiterock soils have developed from them. The true slate rocks and the metasandstone slates are so complexly bedded that the two soil series could not be separated according to differences in origin of parent material. They were separated chiefly on the basis of soil color.

Climate

The summers in the Merced Area are almost rainless and very warm to hot. The winters are cool, and most of the limited rainfall comes between December and March. Most soils are moistened to a depth of several feet, and hardpan and bedrock soils are wet to their full depth.

In spring the plant growth is rapid, but it ceases rather abruptly with the coming of hot weather in May or June and the exhaustion of the limited supply of moisture. Except for the poorly drained soils of the basin and flood plains, these soils are low in organic carbon when com-

[10] See footnote 9.

pared to soils of more humid climates. The short period of plant growth and the rapid oxidation of organic matter during the hot summer allows little organic carbon to accumulate.

The average annual rainfall gradually increases from west to east across the Area. The average rainfall in Le Grand is 3.87 inches higher than that in Los Banos, which is west of the Merced Area. A sharp increase in rainfall—up to about 16 inches per year—occurs along the foothills that border the Area on the east, but only a small part of the Merced Area is affected. Most of the older terrace soils occur under rainfall that ranges from 11 to 12½ inches annually. This range is not enough to cause any important soil differences.

Likewise, temperature variations across the Area are not enough to cause appreciable differences among the soils. Freezing of the soil to a depth of more than a fraction of an inch is very rare, although frost to a depth of 2 to 3 inches occurred in 1948 and at some other times.

The climate is essentially uniform over the Area. The normal zonal soil that is forming under the present mild, semiarid climate appears to be of the Noncalcic Brown great soil group. Noncalcic Brown soils are slightly acid to neutral in the surface soil and neutral or mildly alkaline in the subsoil. The acidity of the older soils in the Area, which have been weathering since early Pleistocene times, suggests that the climate may have been more humid in the past than at present.

Biological forces

The plant cover before the Spanish occupation was apparently grass and small herbaceous plants. Trees grew only along the edges of stream channels and on the flood plains of the Merced and San Joaquin Rivers, where a supply of moisture was available through the summer. A large group of herbs and grasses were annuals that grew rapidly in the spring and matured quickly before summer. They added relatively little organic matter to the soil. Most soils of the Area show the characteristics typical of soils that develop under this kind of grassland.

The only vegetation type that was different enough to cause a different kind of soil to develop was the lush growth of grasses on the poorly drained flood plains. The dark color of the Merced and Temple soils, and to a lesser degree of the Rossi, Landlow, and Burchell soils, is due to organic matter produced by the heavy growth of grasses where natural flooding and poor drainage made extra moisture available.

Relief

The relief, or lay of the land, has had an important bearing on soil development in this Area. The basin in the southwestern part of the Area is nearly level. It is drained only by winding channels of minor streams that drain the foothills to the east. Saline-alkali soils dominate in the basin area, as a result of the poor drainage and high water table.

The young alluvial fans that cover the northwestern part of the Area, the southern edge, and the intensively cultivated area between Merced and Le Grand are very gently sloping or nearly level. They have low ridges of deposited material. The sandier fans have been modified into a gently undulating dune topography. Generally, these soils have not been affected by the water table, but the lowest depressions and old channels show evidence of long-continued waterlogging.

On the older fans the relief is generally undulating. Mounded microrelief is common on the hardpan soils (*17, 20, 24*). The soils on the older fans have adequate runoff, but those that contain a hardpan have very slow internal drainage. The effects of a perched water table resting upon the hardpan are noticeable in many places. The mound microrelief causes rainwater to collect in the depressions between the mounds and thus produces an intricate pattern, or complex, of soils. Typically, the soils on the mounds are well aerated and medium textured, and those in the depressions are medium textured to fine textured and have mottles and cracks that indicate periodic waterlogging.

The higher fans and terraces adjacent to the incised streamways are partly dissected, and there are remnants of gently undulating old surfaces above rolling areas and steep escarpments. Erosion is active, and much of the recently exposed soil material shows little evidence of profile development. The rate of dissection has varied from place to place. Areas where dissection has been rapid have little profile development; more slowly dissected areas have soils of intermediate subsoil development; and undissected areas have strongly weathered soils with a claypan or a claypan-hardpan subsoil.

The soils that developed from material weathered from the bedrock are mainly rolling to steep and generally shallow. Where the slopes are gently undulating to undulating, there is evidence that an overlying mantle of alluvial material has been removed by erosion in relatively recent geologic times, probably during the Pleistocene epoch.

Time

The time factor, or age of the soil, presents many interesting problems in the Merced Area. The study of stratigraphy, physiography, and erosion, and comparison of soil profiles has made it possible to estimate the relative age of a number of soils.

In general, the lowest stream bottoms consist of the most recent alluvium, and the highest terraces or fans are composed of the oldest alluvium. The age of the highest fan establishes the range in age for the various alluvial soils (*23*). In the upper part of figure 17, a number of terraces are indicated by a cross section drawn from topographic maps. The lower part of figure 17 indicates the slopes of the various surfaces and their elevations.

The highest terrace, or fan, has a much steeper gradient than those at lower elevations. This high plane, when projected eastward into the mountains, appears to join with an old landform, the "Mountain valley stage" of downcutting of the Merced River, as described by Matthes (*14*). He ascribes the development of this landform to a stable period during the Pliocene epoch, preceding a major tilting and uplift of the Sierra Nevada block in the late Pliocene or early Pleistocene. This old terrace represents the alluvial fan of a very early period in the canyon-cutting stage, during which the Merced River was entrenched in its present V-shaped gorge. This agrees with the opinion of some geologists that the gravel beds are of orogenic, or mountain-building, origin. Thus the oldest alluvial soils still undissected were laid

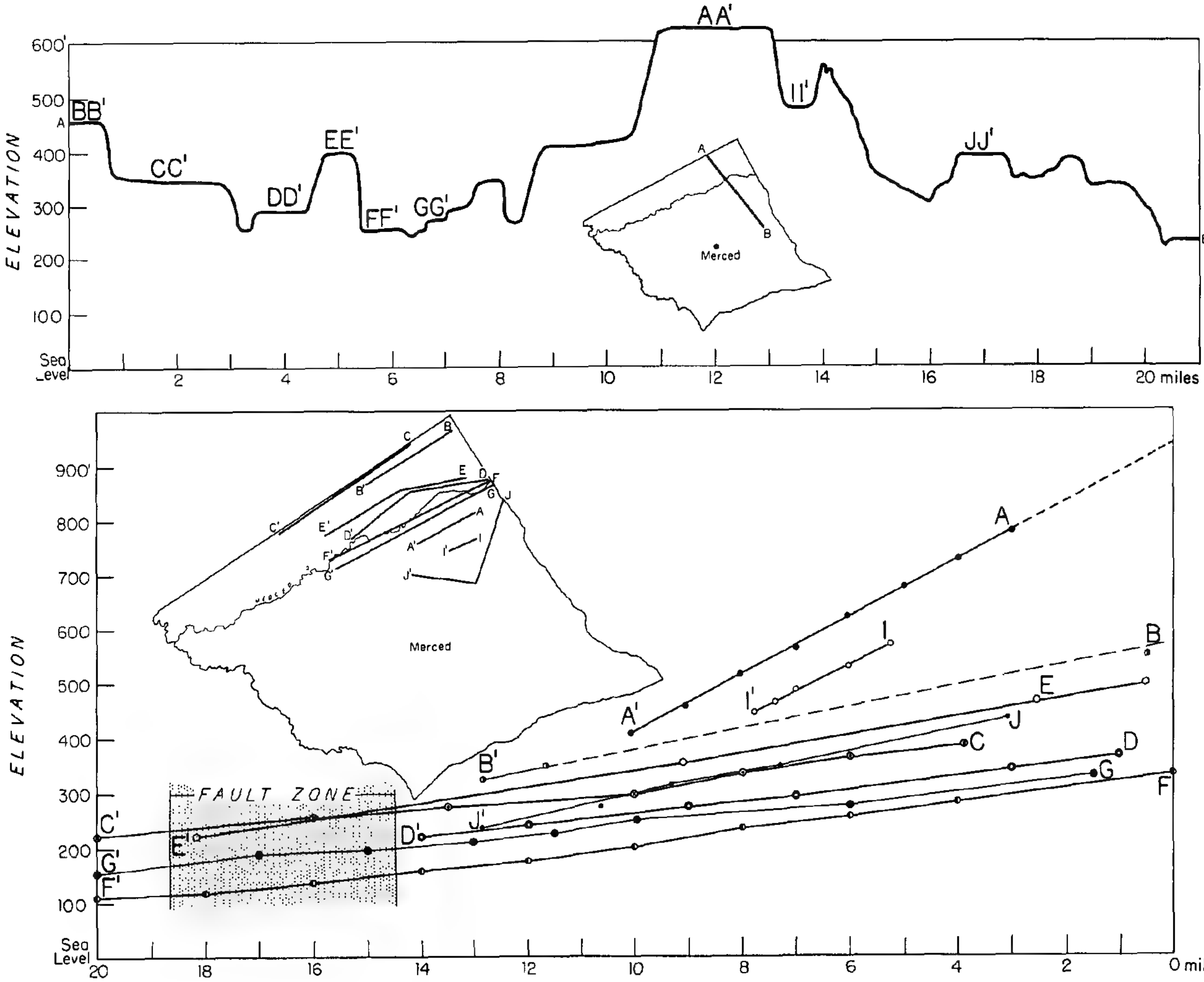

Figure 17.—**Upper figure, cross section of land surface along line AB, parallel to and 6 miles west of the Sierra Nevada foothills. Lower figure, slopes of various depositional surfaces along the lines shown on the sketch map.**

down and began to weather early in the Pleistocene epoch, possibly even earlier. The Sierra Nevada Province tilted westward, largely as a unit, during the late Pliocene and early Pleistocene epochs (*8*), and the age of this gravel is more than half a million years. The character of the soils is compatible with such an age; the profile contains a claypan-hardpan subsoil, the reaction is strongly acid, the fertility is very low, and the stage of weathering appears to be as advanced as that of any soil in the State.

The next lower series of terraces consists of similar mixed gravels, but the surface has a more gentle slope. It may represent a later period of tilting or a period of terrace cutting.

The series of four or five terraces below all consist of nongravelly sandy sediments deposited on a gentle gradient of 9 to 12 feet per mile. The soils on the two oldest of these terraces are the strongly weathered Rocklin and San Joaquin soils, and the Montpellier soils with a distinct clay subsoil. On the younger, lower terraces and fans, the soil profiles become progressively less distinct with decreasing elevation. The soils on the present flood plain have little or no horizon differentiation.

Classification of Soils of the Area

The classification presented in table 9 is based on the scheme presented in Soils and Men (*28*) and subsequently modified by later publications (*5, 18, 26*).

The degree of profile development indicated in table 9 refers only to the amount of clay in the B horizon relative to that in the A horizon. A soil of minimal development has thin, continuous or discontinuous clay films in the B_2 horizon and about 3 to 8 percent more clay in the B_2 than in the A_1 horizon. Maximal development is indi-

cated by a marked increase in clay content of the B_2 horizon and a clear or abrupt upper boundary of the horizon. Clay films are generally thick and continuous in pores and on ped faces. Soils of medial development have a distinct B horizon and an intermediate amount of clay accumulation.

Physical and chemical data for representative soils are given in tables 10 and 11.

TABLE 9.—*Soil series by great soil groups, and certain factors of soil formation*

Great soil group and series	Parent material	Drainage	Degree of profile development
Alluvial soils:			
Hanford	Granitic alluvium	Good	None.
Tujunga	Granitic alluvium	Excessive and somewhat excessive.	None.
Honcut	Basic igneous alluvium	Good	None.
Yolo	Sedimentary alluvium	Good	None.
Anderson	Mixed gravelly alluvium	Good	None.
Columbia	Mixed alluvium, predominantly granitic.	Imperfect	None.
Regosols:			
Delhi	Granitic eolian sands	Somewhat excessive to excessive	None.
Dello	Granitic eolian sands	Poor and imperfect	None.
Hilmar	Granitic eolian sands over silty granitic alluvium.	Poor and imperfect	None.
Lithosols:			
Amador	Rhyolitic tuff	Somewhat excessive and good	None.
Pentz	Andesitic tuff	Somewhat excessive and good	None.
Exchequer	Basic metaigneous rock	Somewhat excessive and good	None.
Daulton	Metasedimentary rock	Somewhat excessive and good	None.
Whiterock	Metasedimentary rock	Somewhat excessive and good	None.
Hornitos	Siliceous sandstone	Somewhat excessive and good	None.
Grumusols:			
Peters	Andesitic tuff	Good	None.
Raynor	Andesitic tuff	Good	None.
Porterville	Basic igneous alluvium	Good	None.
Seville	Basic igneous alluvium	Good	Caliche pan.
Solonetz soils:			
Traver	Granitic alluvium	Good	Minimal.
Waukena	Granitic alluvium	Imperfect	Medial.
Fresno	Granitic alluvium	Imperfect	Medial, with hardpan.
Lewis	Mixed alluvium	Imperfect	Maximal, with hardpan.
Humic Gley soils:			
Grangeville	Granitic alluvium	Imperfect	None.
Foster	Granitic alluvium	Poor and very poor	None.
Pozo	Granitic alluvium	Poor and imperfect	None, with hardpan.
Temple	Granitic alluvium	Poor and imperfect	Minimal.
Landlow	Basic igneous alluvium	Imperfect	Minimal, with weak hardpan.
Burchell	Mixed alluvium, dominantly basic igneous.	Imperfect	Minimal.
Bear Creek	Mixed alluvium	Imperfect	Minimal.
Merced	Mixed alluvium	Poor	Medial.
Alamo	Granitic alluvium	Poor	Medial, with hardpan.
Humic Gley soils with solonetzic properties:			
Rossi	Mixed alluvium, dominantly granitic.	Poor and imperfect	Medial.
Calcium Carbonate Solonchak soils:			
Piper	Mixed alluvium, predominantly granitic.	Imperfect	None.
Noncalcic Brown soils:			
Atwater	Granitic alluvium	Good	Minimal.
Greenfield	Granitic alluvium	Good	Minimal.
Pachappa	Granitic alluvium	Good	Minimal.
Whitney	Granitic alluvium	Good	Minimal.
Dinuba	Granitic alluvium	Imperfect to moderately good	Minimal.

TABLE 9.—*Soil series by great soil groups, and certain factors of soil formation*—Continued

Great soil group and series	Parent material	Drainage	Degree of profile development
Noncalcic Brown soils:—Con.			
Wyman	Basic igneous alluvium	Good	Minimal.
Auburn	Basic igneous rock	Good	Minimal.
Marguerite	Mixed alluvium, dominantly sedimentary.	Good	Minimal.
Borden	Granitic alluvium	Good	Medial.
Snelling	Granitic alluvium	Good	Medial.
Sesame	Granite	Good	Medial.
Ryer	Basic igneous alluvium	Good	Medial.
Rocklin	Granitic alluvium	Good	Medial, with hardpan.
Montpellier	Granitic alluvium	Good	Maximal.
Corning	Mixed alluvium	Good	Maximal.
Hopeton	Mixed alluvium	Good	Maximal.
Madera	Granitic alluvium	Good	Maximal, with hardpan.
San Joaquin	Granitic alluvium	Good	Maximal, with hardpan.
Yokohl	Basic igneous alluvium	Good	Maximal, with hardpan.
Keyes	Mixed alluvium	Good	Maximal, with hardpan.
Redding	Mixed gravelly alluvium	Good	Maximal, with hardpan.

Alluvial soils

The Alluvial great soil group is made up of soils formed on alluvium deposited on flood plains or alluvial fans in relatively recent times. Weathering processes have had slight effect upon the soil material and have produced little or no differentiation between horizons. There is a little organic matter in the upper part of the profile, but no discernible textural B horizon. Thus, the soils in this group have, at most, weak A–C profiles. They are relatively uniform, except for some stratification in texture, from the surface down to considerable depth.

The Alluvial soils in the Merced Area are of the Hanford, Tujunga, Honcut, Yolo, Anderson, and Columbia series. A soil representative of this group, Hanford sandy loam, was observed 3 miles south-southeast of El Nido. It is a well-drained soil formed from sandy granitic alluvium.

A_{1p} 0 to 12 inches, sandy loam; pale brown (10YR 6/2.5) when dry, brown (10YR 4.5/3) when moist; very weak, very fine, granular structure when moist, essentially massive when dry; slightly hard when dry, very friable when moist, nonplastic and nonsticky when wet; contains numerous roots and wormholes; pH 7.4; gradual, smooth boundary.

C 12 to 60 inches, sandy loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; contains numerous roots and some worm and insect burrows; slightly stratified with coarser and finer sandy loams; pH 7.5.

The most obvious features that separate the Alluvial soils into different series are the kinds of parent material and the color differences due to parent material and drainage.

The Tujunga series consists of excessively drained and somewhat excessively drained soils developed from coarse-textured granitic alluvium. The Hanford, Honcut, Yolo, and Anderson soils are well drained. The Honcut soils developed in moderately coarse textured and medium textured alluvium derived from basic igneous rocks; they may have some moderately fine textured strata. The Yolo soils formed in medium-textured alluvium derived from dark-colored slate. The Anderson soils developed in moderately coarse textured and medium textured gravelly alluvium of mixed origin. The Columbia soils are imperfectly drained. They developed in moderately coarse textured and medium textured materials of mixed, but dominantly granitic, origin.

Except for the Columbia soils, all of these are pale brown to grayish brown, very deep, moderately to very rapidly permeable, and high in mineral fertility. The medium-textured members of this group are among the most productive agricultural soils of the Area. The Columbia soils are mottled below the surface soil because of the periodic high water table and occasional overflow. Where drained and protected from flooding, they are productive soils.

Noncalcic Brown soils

Twenty-one series in this Area were identified as Noncalcic Brown soils. This great soil group has been described as a zonal group of soils that have a slightly acid, light pinkish or light reddish-brown A horizon over a light reddish-brown or dull-red B horizon and that developed under mixed grass and forest vegetation in a subhumid, wet-dry climate (*28*).

The genesis of the Noncalcic Brown soils can be understood only from a detailed consideration of the climatic factors involved. In the eastern part of the Area, where these soils are found, the rainfall is normally between 11 and 15 inches per year, and the average annual temperature is about 60° F. Such rainfall and temperature occur also in southeastern New Mexico, where the soils are largely calcareous throughout and desertic conditions prevail. The Noncalcic Brown soils in the Merced Area are leached of lime, whereas the soils of New Mexico are not. The explanation is that, although the summer and winter temperatures are about the same in the two areas, the rainfall distribution is reversed. In southeastern New Mexico, most of the rainfall comes during the warm season, from April to September, whereas in the Merced Area it is concentrated during the coolest part of the year, from November to March.

In the Merced Area, the winter temperature ranges from 44° to 54° F., and there is an occasional frost and much cool, foggy weather. The vegetation of annual grasses and herbs grows very slowly during this period.

Little of the rainfall is lost through evaporation or transpiration until the temperature begins to rise rapidly late in March. Under these conditions, the rainfall is particularly effective and penetrates deeply into the soil, especially in wetter years. About 40 percent of the time the annual rainfall is more than 14 inches, and in these years moisture penetrates through the solum.

In the spring, chemical weathering processes and microbiological activity increase rapidly as the soil warms. By the middle of May or the first of June, the supply of moisture is exhausted, the vegetation turns brown, and chemical weathering processes become relatively ineffective. Due to the short period of active weathering, the production of clay is slow, and the solution of mineral material is even slower. Consequently, rainfall in the occasional wet years is just about equal to the task of leaching the more mobile products of weathering. The clay that forms is less mobile and accumulates gradually in the subsoil. Because the summers are hot and dry, little organic matter accumulates in the surface soil. The weak organic acids produced displace few cations from the clay that are not replaced by weathering of fresh minerals. In the older soils the supply of fresh minerals is gradually reduced and acidity tends to increase.

In table 9 the Noncalcic Brown soils have been classified according to their degree of development as minimal, medial, and maximal. Some soils of medial and maximal development have hardpans.

Minimal Noncalcic Brown soils.—The soils in this subgroup have many properties similar to those of the well-drained Alluvial soils, but they have a recognizable B horizon that contains slightly more clay than the A horizon. The soils in this subgroup are the Atwater, Greenfield, Pachappa, Whitney, Dinuba, Wyman, Auburn, and Marguerite.

A representative profile of a soil in this subgroup, Wyman clay loam, 4¼ miles east-northeast of Merced in the NW¼ sec. 14, T. 7 S., R. 14 E., is as follows:

A_{1p} 0 to 5 inches, light clay loam; brown (7.5YR 4.5/3) when dry, dark brown (7.5YR 4/2) when moist; weak, fine, granular structure when moist, essentially massive when dry; hard when dry, friable when moist, plastic and slightly sticky when wet; contains numerous roots, insect burrows, and wormholes; moderately low in organic matter; pH 6.5; clear, smooth boundary.

A_3 5 to 14 inches, similar to the horizon above except that the soil is slightly more compact, probably because of tillage practices. The lower boundary is gradual and smooth.

B_2 14 to 30 inches, clay loam; brown (7.5YR 5/4) when dry, dark brown (7.5YR 4/4) when moist; weak, medium, blocky structure; thin, slightly darker, nearly continuous clay films on the blocks; hard when dry, friable when moist, plastic and sticky when wet; contains a moderate number of roots and some burrows made by insects and worms; pH 6.8; gradual, smooth boundary.

B_3 30 to 41 inches, silty clay loam; brown (7.5YR 5/4) when dry, dark brown (7.5YR 4/4) when moist; weak, medium and coarse, blocky structure to nearly massive; thin, slightly darker, nearly continuous clay films on blocks; hard when dry, friable when moist, plastic and sticky when wet; contains some roots, mainly in cracks; pH 7.0; diffuse, smooth boundary.

C 41 inches +, stratified silt loam, clay loam, and loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; massive; variable in consistence; pH 7.0; alluvium derived mainly from basic igneous rocks.

The A horizon of the soils in this subgroup ranges in color from pale brown to brown or light reddish brown, except that of the Marguerite soils, which has inherited a dark color from gray, graphitic, alluvial parent material derived from slates. The B_2 horizon is brown or reddish brown, except in the Marguerite soils, which have a grayish-brown B_2 horizon. The reaction is neutral to slightly acid in the A horizon and neutral to mildly alkaline in the B horizon. The Atwater soils have been modified somewhat by the wind; their surface is sand and loamy sand in texture and paler in color than that of the other soils in the group. The Dinuba soils have been slightly affected by restricted drainage, are faintly mottled, and have some lime just above an unrelated silty substratum. The Whitney soils formed on weakly consolidated granitic sediments, the Auburn soils on basic schist, and the rest on alluvial fans and terraces that no longer receive deposits of soil material. The Greenfield soils are similar to the Wyman, except that they are moderately coarse textured and they formed on granitic alluvium. In the Merced Area, the Greenfield soils are underlain by an unrelated hardpan substratum. The Pachappa soils are similar to the Greenfield soils except that they have lime and, in many places, adsorbed sodium (alkali) in the lower part of the B horizon.

The Auburn soils in the Merced Area occupy lower foothills where rainfall is less than that under which the Auburn soils more commonly develop. At these lower elevations, the Auburn soils tend to be less porous, less granular, slightly less acid, and slightly less red than the typical Auburn soils of the higher and more humid areas to the east.

A typical profile of Auburn silt loam, located in the northeast corner of Merced County, 200 yards south-southeast of the center of sec. 1, T. 4 S., R. 14 E., follows:

A_{1p} 0 to 5 inches, silt loam; brown (7.5YR 5/4) when dry, dark brown (7.5YR 4/4) when moist; weak, fine, granular structure when moist, and weak, medium and coarse, subangular blocky to essentially massive when dry; hard when dry, friable when moist, plastic and slightly sticky when wet; contains many fine roots and very fine pores; moderate in organic matter; pH 6.0; clear, smooth boundary.

B_1 5 to 10 inches, light silty clay loam; reddish brown (5YR 4/4) when dry, dark reddish brown (5YR 3/4) when moist; weak, fine and medium, subangular blocky structure; thin, patchy clay films, darker reddish brown (5YR 4/3; 3/3) when moist, coat the blocks; hard when dry, friable when moist, plastic when wet and slightly stickier than A_{1p} horizon; contains fewer fine roots but has larger and more numerous pores than surface soil; pH 6.2; clear, smooth boundary.

B_2 10 to 16 inches, light silty clay loam; reddish brown (5YR 4/3) when dry, dark reddish brown (5YR 3/3) when moist; weak, fine, angular blocky structure; thin, almost continuous, reddish-brown when dry, dark reddish-brown when moist, clay films on blocks; hard when dry, friable when moist, plastic and slightly stickier than A_{1p} horizon when wet; contains few fine roots, but pores are larger and more numerous than in A_{1p} horizon; pH 6.3; abrupt, irregular boundary.

D_r 16 inches +, slightly altered greenstone (metamorphosed basic igneous rock); greenish in color but with reddish-brown and reddish stains and soil material on the immediate surface; somewhat shattered in the upper part but altered little or none within a few inches; tilted at a high angle, nearly vertical in places; hardness and composition vary within short distances.

Medial Noncalcic Brown soils without hardpans.—The Borden, Snelling, Sesame, and Ryer soils are included in this subgroup. All have accumulated moderate amounts of clay in their B_2 horizon. The Ryer series is typical. A representative profile of Ryer silt loam in the SW¼ sec. 34, T. 4 S., R. 13 E., is as follows:

A_1 0 to 10 inches, silt loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; very weak, fine, platy structure and weak, fine, granular structure when moist, essentially massive when dry; hard when dry, friable when moist, slightly plastic but nonsticky when wet; contains numerous worm and insect burrows and numerous fine grass roots; low in organic matter; pH 5.7; clear, smooth boundary.

B_1 10 to 20 inches, heavy silt loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; weak, medium, blocky structure; thin, patchy clay films on blocks; hard when dry, friable to firm when moist; slightly plastic and slightly sticky when wet; pH 5.7; clear, smooth boundary.

B_2 20 to 44 inches, heavy clay loam; brown (10YR 5/3) when dry, dark brown (10YR 4/3) when moist; moderate, medium, blocky structure; moderately thick, continuous, dark-brown (7.5YR 4/4) when dry, dark-brown (7.5YR 3/4) when moist, clay films on blocks: very hard when dry, firm when moist, plastic and sticky when wet; roots are concentrated somewhat in seams; slightly acid in the upper part, grading to neutral in the lower part, pH 6.2 to 7.3; gradual, smooth boundary.

B_3 44 to 64 inches, light clay loam; brown (10YR 5/3) when dry, dark brown (10YR 4/3) when moist; weak, medium and fine, blocky structure; thin, patchy, dark-brown clay films on blocks; very hard when dry, firm when moist, plastic and slightly sticky when wet; contains a few roots; contains very slight traces of lime, pH 7.8; diffuse boundary.

C 64 to 84 inches, slightly stratified loam and very fine sandy loam; light yellowish brown (10YR 6/4) when dry, brown (10YR 5/4) when moist; massive; hard when dry, friable when moist, slightly plastic and nonsticky when wet; pH 6.7; alluvium derived mainly from basic igneous rocks.

The color of the A horizon of soils in this subgroup ranges from pale brown to dark brown or grayish brown; the B horizon is brown, grayish brown, or reddish brown. The reaction is slightly acid in the A horizon and slightly acid to moderately alkaline in the B horizon, except in the Borden soils, which are in many places strongly alkaline in the B horizon.

The Borden series appears to have been affected by a high water table during its early history and probably was formerly affected by salts. However, it is now well drained, and most of the salts have been removed. The saline or alkali phases are high in adsorbed sodium, and many of them have little or no salt left. Thus the Borden series appears to be intergrading between the Solonetz and Noncalcic Brown great soil groups.

The Snelling soils formed from granitic alluvium. They are coarser textured than the Ryer soils. They have sandy loam A and C horizons and a light sandy clay loam B_2 horizon. The Sesame soils are rocky and moderately deep. They formed directly from granodiorite rock. The other members of the subgroup formed from alluvium on moderately old alluvial fans and terraces.

Medial Noncalcic Brown soils with hardpans.—The Rocklin soils are the only representatives of this subgroup in the Merced Area. They developed in granitic alluvium. A representative profile of Rocklin fine sandy loam a quarter of a mile south of the northwestern corner of sec. 22, T. 5 S., R. 12 E., is described as follows:

A_1 0 to 8 inches, fine sandy loam; light brown (7.5YR 6/4) when dry, dark brown (7.5YR 4/4) when moist; essentially massive when dry, very weak, very fine, granular structure when moist; hard when dry, very friable when moist; low in organic matter; contains many fine tubular pores; pH 6.1; clear, smooth boundary.

B_2 8 to 24 inches, heavy loam; yellowish red (5YR 5/6) when dry, yellowish red (5YR 4/5) when moist; moderate, fine, subangular blocky structure; thin, nearly continuous clay films on blocks; hard when dry, friable when moist; very low in organic matter; fine tubular pores; pH 6.2 to 6.8; abrupt, smooth boundary.

C_m or C 24 to 60 inches +, weakly to moderately consolidated stratified fine sandy loam; reddish yellow (5YR 6/6 and 6/8) when dry, yellowish red (5YR 5/6 and 5/8) when moist; massive; very hard when dry, very firm when moist; neutral; a very thin section at the top of this layer, in most places less than one-fourth inch thick, is strongly cemented to indurated with iron and silica; this cementing material is also present in vertical cracks that run deep into the substratum in a very coarse, polygonal or prismatic pattern.

Maximal Noncalcic Brown soils without hardpans.—Soils of three series, the Montpellier, Corning, and Hopeton, are classified in this subgroup. They are found on old landscapes, partly dissected by erosion into undulating, rolling, or hilly topography. The soil profile is strongly developed. The B horizon is well defined and much higher in clay content than that of the Medial Noncalcic Brown soils. In a few moist spots there is a very thin A_2 horizon, lighter colored than the A_1 horizon and faintly mottled. Here, these soils grade toward Planosols.

Montpellier coarse sandy loam is typical of these soils. A typical profile, 1¾ miles east of Yosemite Lake in the NE¼ sec. 25, T. 6 S., R. 14 E., is as follows:

A_1 0 to 18 inches, coarse sandy loam; brown (7.5YR 5/4) when dry, dark brown (7.5YR 4/4) when moist; very weak, very fine, granular structure when moist, essentially massive when dry; hard when dry, friable when moist, nonplastic and nonsticky when wet; low in organic matter; contains numerous worm and insect burrows and numerous fine roots and pores; pH 6.5; clear, smooth boundary.

A_3 18 to 21 inches, coarse sandy loam; brown (7.5YR 5/4) when dry, dark brown (7.5YR 4/4) when moist; contains a few, fine, faint mottles of light gray (7.5YR 7/1) and pinkish gray (7.5YR 7/2) when dry and gray and pinkish gray (7.5YR 6/2) when moist; very weak, very fine, granular structure when moist, essentially massive when dry; hard when dry, friable when moist, nonplastic and nonsticky when wet; low in organic matter; contains numerous worm and insect burrows and numerous fine roots and pores; pH 6.5; abrupt, slightly wavy boundary.

B_{21} 21 to 28 inches, light sandy clay loam; between red and reddish brown (2.5YR 5/5) when dry, red (2.5YR 4/6) when moist; weak, medium, blocky and weak, coarse, prismatic structure; moderately thick, dark reddish-brown (2.5YR 3/4) when moist, continuous clay films on blocks; very hard when dry, firm when moist, plastic and sticky when wet; contains few roots, except in cracks, and few very fine pores; pH 7.0; gradual, smooth boundary.

B_{22} 28 to 40 inches, light sandy clay loam; between red and reddish brown (2.5YR 5/5) when dry, red (2.5YR 4/6) when moist; weak, coarse, blocky structure that approaches massive; moderately thick, continuous clay films, dark reddish-brown (2.5YR 3/4) when moist, on blocks; very hard when dry, firm when moist, plastic and sticky when wet; contains few roots, except in cracks, and few very fine pores; pH 7.0; diffuse boundary.

C 40 inches +, coarse sandy loam slightly stratified with very fine gravelly sandy loam; yellowish red (5YR 5/6) when dry, darker yellowish red (5YR 4/6) when moist; massive; hard when dry, firm when moist, nonplastic and slightly sticky when wet; pH 7.5; old granitic alluvium that contains grains of mica and partly weathered feldspar as well as quartz.

The soils of this subgroup have a dark-brown, brown, or reddish-brown A horizon that lies directly over a reddish-brown to red B_2 horizon. The A horizon ranges in texture from fine to moderately coarse, and the B_2 horizon is fine textured or nearly so. The soils are slightly acid to medium acid in the upper part of the solum but become less acid in the lower part of the B horizon and the underlying horizons.

The Montpellier and Corning soils formed from alluvium on old fans and terraces; and the Hopeton soils developed from weakly consolidated sediments derived from mixed igneous rocks. The Corning soils are gravelly throughout; they formed from very gravelly alluvium derived from mixed igneous and metamorphic rocks. The Hopeton soils are finer textured than the Montpellier and have small amounts of segregated lime in the lower part of the B horizon.

Maximal Noncalcic Brown soils with hardpans.—This subgroup includes the Madera, San Joaquin, Keyes, Redding, and Yokohl series. Their outstanding characteristic is a strong textural B horizon overlying an iron-silica cemented hardpan. A representative soil of this subgroup is San Joaquin sandy loam. The profile described below was observed one-fourth mile northwest of the Marguerite station in the SW¼sec. 1, T. 9 S., R. 16 E.:

A_1 0 to 13 inches, sandy loam, nearly fine sandy loam; yellowish red (5YR 5/6) when dry, reddish brown (5YR 4/4) when moist; very weak, very fine, granular structure when moist, essentially massive when dry; very hard when dry, very friable when moist, nonplastic and nonsticky when wet; low in organic matter; contains numerous roots and wormholes; pH 5.9 to 5.7; clear, smooth boundary.

B_1 13 to 20 inches, sandy clay loam; reddish brown (5YR 5/4) when dry, darker reddish brown (5YR 4/4) when moist; weak, medium and fine, blocky structure; thin, patchy clay films on blocks; hard when dry, firm when moist, slightly plastic and sticky when wet; contains numerous roots but few wormholes; pH 6.1; abrupt, smooth boundary.

B_2 20 to 25 inches, clay; reddish brown (2.5YR 4/4) when dry, dark reddish brown (2.5YR 3/4) when moist; strong, medium, prismatic structure; thick, continuous clay films on prisms, weak red (10R 4/2) when dry, dusky red (10R 3/2) when moist; extremely hard when dry, very firm when moist, very plastic and very sticky when wet; contains a few roots in cracks and matted beneath the prisms; pH 6.2; abrupt, smooth boundary.

C_{m1} 25 to 27 inches, indurated iron-silica hardpan; reddish brown (5YR 5/4) when dry, darker reddish brown (5YR 4/4) when moist; impermeable; does not slack in water and can be dissolved only with alternate treatments of hot strong acid and alkali; very thin, platy structure, grading to massive below.

C_{m2} 27 to 40 inches, weakly cemented hardpan that resembles sandstone of granitic origin; light brownish gray (10YR 6/2) when dry, grayish brown (10YR 5/2) when moist; contains seams of hard, very pale-brown material, probably silica; pH 7.9, a little segregated lime in thin seams.

C_2 40 inches +, stratified granitic sandy loam and fine sandy loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; massive; hard to softly consolidated when dry, firm when moist, nonsticky and nonplastic when wet.

The Keyes soils and Madera loams have dark colors inherited from dark-colored parent material. The San Joaquin, Redding, and Yokohl soils and Madera sandy loams are brown, reddish brown, or yellowish brown in the A horizon and reddish brown, red, or yellowish red in the B horizon. The hardpan layers are brown or reddish brown. The reaction of the Redding soils is medium acid to strongly acid throughout; that of the others in the group is slightly acid to medium acid in the surface soil and slightly acid to mildly alkaline in the subsoil. In many places the Madera and Yokohl soils are intermittently slightly calcareous in the B_2 horizon just above the hardpan and have thin seams of segregated lime in the hardpan and below.

In some places the Redding soils have a thin, light-gray A_2 horizon. The Redding soils are very old, probably hundreds of thousands of years (*19*). Time alone might account for this kind of soil under the present climate. Or, this soil may be the product of weathering under several different kinds of climate. Some changes in climate are known to have occurred in this area during the later part of the Pleistocene epoch. During glacial periods the rainfall in the high Sierra Nevada was probably somewhat greater than at present. The oldest Redding soils on the highest remnants of terraces and fans are strongly weathered to great depths beneath the hardpan. This suggests that the hardpan has been formed relatively recently, perhaps under a climate similar to that which now exists. The San Joaquin soils have some of the same characteristics and are thought to be very old also, but not so old as the Redding soils.

Stratification and perched moisture appear to be factors in the formation of cemented hardpans of this kind. Incipient iron-silica cementation has been noted in fairly recent alluvium, but only where the profile is distinctly stratified and perched moisture collects just above the less permeable stratum. In old, uniformly permeable material, as for example in the Montpellier soils, no hardpan has formed. Under a climate that is dry in summer and wet in winter, the soil accumulates moisture, is warmed enough to allow rapid chemical and biotic activity for a short period in the spring, and then dries out rapidly during the hot summer. Under these conditions, silica and sesquioxides are dissolved, and then they are irreversibly precipitated as the soil dries out. In this way the less permeable substratum is gradually cemented into an impermeable layer.

Grumusols

The name Grumusol was proposed for a great soil group by Oakes and Thorp in 1950 (*18*). This group includes clay soils that have a dark color of low chroma. They have a crumbly granular structure, or gilgai microrelief, or both. The coefficient of expansion and contraction is high, and the soil is very plastic. Most of the parent materials are calcareous. The montmorillonitic clays are nearly saturated with calcium or with calcium and magnesium. Tall grass or savanna is the natural vegetation. The soils are medium to low in organic matter. There are no eluvial or illuvial horizons.

On the basis of these characteristics, four soil series in the Merced Area are considered to be Grumusols. These are the Porterville, Raynor, Peters, and Seville series. They all show most of the characteristics described above.

The Porterville soils are dark reddish brown, with a chroma of 2 to 4. Lime is present only in the subsoil and parent material, except for a few nodules in the surface soil. A representative profile of Porterville clay, 1½ miles northwest of Le Grand, is as follows:

A_{11} 0 to 13 inches, clay; dark reddish brown (5YR 3/2) when dry, darker reddish brown (5YR 2/2) when moist; strong, very coarse, blocky structure that forms "adobe" blocks 12 to 18 inches across separated by cracks up to 3 inches in width; when completely dry, large blocks break down to fine blocks, which form a loose mulch on the surface of the larger blocks; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; contains numerous fine roots; pH 7.3 to 7.7, contains a few hard lime concretions 5 to 15 millimeters in diameter; diffuse boundary.

A_{12} 13 to 48 inches, clay; dark brown (7.5YR 3/2) when dry, very dark brown (7.5YR 2/2) when moist; moderate, very coarse, blocky structure with numerous slickensides; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; slightly calcareous with numerous blotches and rounded, hard concretions of lime, pH 8.1 to 8.2; gradual, wavy boundary.

C 48 to 72 inches, stratified clay, dark brown (7.5YR 4/2) when dry, darker brown (7.5YR 3/2) when moist, and fine sandy loam, olive gray (5Y 5/2) when dry, olive gray (5Y 4/2) when moist; weak, blocky structure or massive; hard when dry, very firm when moist, slightly sticky to sticky and slightly plastic to plastic when wet; slightly calcareous, with blotches and seams of lime, and less calcareous with depth, pH 8.3.

The Raynor soils are very dark gray or dark gray, with a chroma of 1 or less. The parent material is andesitic tuff, which is free of lime but rich in calcium. The surface soil is slightly acid and free of lime, but carbonates appear below a depth of 16 inches and increase to about 3 percent at a depth between 33 and 48 inches. The organic-matter content is less than 1 percent; it varies from 0.72 percent in the upper 16 inches to 0.37 percent in the next lower layer, which extends to a depth of 33 inches, and to 0.48 percent in the layer that extends to a depth of 48 inches. The Raynor soils thus are lower in organic matter than typical Grumusols.

The Peters series appears to represent an intermediate stage of development between the Pentz (Lithosol) and the Raynor (Grumusol) series. These three soils formed from the same kind of parent material—andesitic tuff. The differences appear to be due to variations in the length of time of exposure to weathering and to differences in topography, erosion, and moisture. The Pentz soils are on steep or convex slopes, the Peters soils on less steep, concave slopes, and the Raynor soils on gentle, concave slopes or old, gently sloping landscapes. The Pentz soils are shallow, the Peters soils are slightly deeper but still shallow, and the Raynor soils are moderately deep to deep. Colors become progressively darker and grayer as the depth increases. The Peters soils are dark gray and slightly acid. The wide cracking and coarse, blocky structure of the surface soil are not so well developed in the Peters soils as in the Raynor soils. The clay content is lower in the Peters soils than in the Raynor, and the soils are somewhat less plastic.

In color the Seville soils are similar to the Porterville soils. The texture is uniform to a depth of 20 inches. The lime content of a representative profile increases from 0.7 percent at the surface to 4.5 percent in the lower part of the 20-inch depth. Below 20 inches is a strongly cemented caliche hardpan about 3 inches thick. The lime content is about 17 percent. Below the hardpan the lime content decreases to 2 to 4 percent, but the pH increases to 8.7. This suggests that a high water table may have been responsible for some of the characteristics of these soils. However, the gently undulating topography makes this seem less likely. It is possible that the parent material was of lacustrine origin and was originally alkaline throughout. Another possibility is that the material below the hardpan is unrelated to the surface material, but there is not enough data to support or refute this idea.

The gilgai microrelief typical of many dark-colored clays was not observed on any of these soils, even where uncultivated.

Lithosols

Lithosols have an incomplete solum or no clearly expressed soil morphology. They consist of a freshly and imperfectly weathered mass of hard rock or hard rock fragments, generally on steeply sloping land (*25*).

In the Merced Area, six soil series are included in this group: Amador, Exchequer, Daulton, Whiterock, Hornitos, and Pentz. These soils are shallow or very shallow, and rock outcrops are common. They are separated mainly on the basis of differences in parent material, which cause differences in the color and texture of the soils. There is little or no profile development except in small spots protected from erosion.

The Daulton soils formed from graphitic slates, which give the soils their gray or dark grayish-brown color. The reaction is medium acid, and the depth ranges from 4 to 18 inches. Rock outcrops are numerous.

A representative profile of Daulton rocky silt loam, a quarter of a mile west of the Mariposa County line on the Merced and Hornitos Road, is as follows:

A_1 0 to 11 inches, silt loam that contains numerous thin fragments of slate ¼ to 1 inch long; gray (10YR 5/1) when dry, dark gray (10YR 4/1) when moist; weak, fine, granular structure when moist, essentially massive when dry; hard when dry, friable when moist, slightly plastic and nonsticky when wet; moderately low in organic matter (1 to 2.5 percent); contains numerous roots and many burrows made by worms and insects; pH 5.6; abrupt, irregular boundary.

D_r 11 inches +, slate that contains chiastolite crystals and graphite; gray (10YR 5/1) when dry, dark gray (10YR 4/1) when moist; the slate has nearly vertical cleavage; outcrops of slate rock are numerous.

Amador loam formed on rhyolitic tuff, which is strongly acid. This soil is very pale brown, strongly acid, and very low in mineral fertility. It is generally very shallow, but the depth ranges from 0 to 14 inches because of the pronounced mound microrelief.

The Exchequer soils are yellowish-red silt loam that formed on basic metaigneous rocks. The reaction is slightly acid, and the depth ranges from 4 to 18 inches. Tombstonelike outcrops of rock are common.

Whiterock soils formed on fine-grained metasandstone and slate. They are similar to the Daulton soils, except that they are pale brown to light yellowish brown.

The Hornitos series formed on siliceous sandstone of Eocene age, which contains little material that can be weathered further. There are many outcrops of sandstone. The soils are strongly acid fine sandy loam. They vary in color from pale brown to light reddish brown,

depending upon the color of the sandstone. Mineral fertility is low, and the forage produced is poor in nutritional value.

In contrast, the Pentz soils produce nutritious forage. Their color is grayish brown, and their reaction is slightly acid. Their parent material is andesitic tuff. Nearly level beds of hard mudstone, 3 to 20 feet thick, are interbedded with the softer material. The topography is undulating to steep. Rock outcrops occur in bands across the slopes. These soils are of loam or clay loam texture, but they appear to weather rapidly to clay on concave slopes. The clay soils are darker in color and are separated as the Peters series.

Regosols

Regosols consist of deep, unconsolidated rock or soft mineral deposits in which few or no clearly expressed soil characteristics have developed. Examples are recent sand dunes and loess and glacial drift on steep slopes (*26*). Three series made up of wind-laid sand are represented in the Merced Area: the Delhi, Dello, and Hilmar. These soils formed from sand of granitic origin. They are separated mainly on the basis of drainage and reaction.

The Delhi soils consist of loose, excessively drained sand and somewhat excessively drained loamy sand. They are uniform in texture to considerable depth. A dune microrelief was common, but most of the acreage has been leveled for cultivation. The sand is of recent origin. It contains considerable unweathered feldspar and mica, which furnish adequate mineral fertility for most crops adapted to sandy soils, but it is deficient in some minor elements for other crops.

A representative profile of Delhi sand, 2 miles southeast of Delhi, is as follows:

C_1 0 to 12 inches, sand; light brownish gray (10YR 6/2) when dry, brown (10YR 5/3) when moist; single grained; loose whether dry or moist, nonsticky and nonplastic when wet; very low in organic matter; contains numerous grass roots; pH 6.5; clear, wavy boundary.

C_2 12 to 44 inches, sand; light yellowish brown (10YR 6/4) when dry, yellowish brown (10YR 5/4) when moist; single grained; loose whether dry or moist, nonsticky and nonplastic when wet; pH 6.5; contains some fine roots but is very low in organic matter; diffuse boundary.

C_3 44 to 68 inches, sand, sorted into thin laminations of fine and medium sands; light yellowish brown (10YR 6/4) when dry, yellowish brown (10YR 5/4) when moist; single grained; loose whether dry or moist, nonsticky and nonplastic when wet; pH 6.5; cross-bedding due to wind is clearly visible.

The Dello soils are in depressions, where the water table occasionally approaches the surface. They are associated with the Delhi soils. The Dello soils are darker colored than the Delhi, due to a slight accumulation of organic matter. In addition, they are mottled in the subsoil in imperfectly drained areas. In poorly drained spots they are mottled throughout, in many places with the bluish mottling that accompanies reduction of iron. Weak concentrations of salts are often found around the margins of the most poorly drained areas.

The Hilmar soils consist of eolian sands blown over areas of unconforming, slightly calcareous, silty materials similar to those of the Dinuba soils. Imperfect and poor drainage have permitted the upward movement of salts, and in many places a thin salt zone is at the top of the moist zone in the soil.

Solonetz soils

Solonetz soils usually have a friable A horizon that varies in thickness, and a dark-colored, strongly alkaline, hard B_2 horizon with columnar structure. They occur in subhumid or semiarid climates under grass and shrub vegetation (*28*).

Four series of the Merced Area are classified in this group: the Waukena, Fresno, Lewis, and Traver. The soils in these series differ in the degree of development and in the presence or absence of a lime-silica cemented hardpan. They formed from alluvium in basin areas. They are generally affected by a high water table. The areas are nearly level, except for the distinct mounds that, in the Merced Area, are associated with hardpan and claypan soils. The plant cover on uncultivated areas consists of saltgrass and salt-loving plants. The cover is very sparse in strongly saline-alkali areas but is nearly continuous in areas less affected by salts and alkali. The reaction is generally strongly alkaline (pH 8.5 to 10).

The Waukena soils have moderately well developed solonetzic profiles. They formed on granitic alluvium of medium texture. The depth to the water table fluctuates from 2 to 5 feet. A representative profile of Waukena fine sandy loam is as follows:

A_{11} 0 to 1 inch, fine sandy loam; light gray (10YR 6/1) when dry, gray (10YR 5/1) when moist; weak, fine, vesicular structure, but otherwise essentially massive; slightly hard when dry, friable when moist, slightly plastic and slightly sticky when wet; pH 7.6, noncalcareous; abrupt, smooth boundary.

A_{12} 1 to 10 inches, fine sandy loam; gray (10YR 5/1) when dry, dark gray (10YR 4/1) when moist; weak, very fine, granular structure when moist, essentially massive when dry; slightly hard when dry, friable when moist, slightly plastic and slightly sticky when wet; contains numerous fine roots and fine pores; moderately low in organic matter; pH 7.6, noncalcareous; abrupt, smooth boundary.

A_2 and B_{21} 10 to 18 inches, sandy clay loam; light yellowish brown (2.5Y 6/4) when dry, light olive brown (2.5Y 5/4) when moist; strong, medium and coarse, columnar structure with distinct gray (10YR 5/1) coatings on the rounded caps and fingering down the columns; thin, continuous clay films on columns; very hard when dry, very firm when moist, plastic and sticky when wet; roots mainly between the columns; pH 9.3, slightly calcareous; gradual, smooth boundary.

B_{22} 18 to 27 inches, sandy clay loam; light yellowish brown (2.5Y 6/4) when dry, light olive brown (2.5Y 5/4) when moist; moderate, medium, blocky structure; thin, continuous clay films on blocks; hard when dry, firm when moist, plastic and sticky when wet; contains a very few roots, mostly on structural surfaces; pH 10.0, slightly calcareous; gradual, smooth boundary.

B_3 27 to 39 inches, sandy clay loam; light yellowish brown (2.5Y 6/4) when dry, light olive brown (2.5Y 5/4) when moist; weak, medium, subangular blocky structure; thin, patchy clay films on blocks; contains very few roots; pH 9.9, slightly calcareous, with some hard nodules up to one-half inch in diameter; gradual, smooth boundary.

C 39 to 60 inches +, stratified fine sandy loam and clay loam; light gray (2.5Y 7/2) to light brownish gray (2.5Y 6/2) when dry, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, firm to friable when moist; pH 9.6, slightly calcareous, lime mostly disseminated.

The Fresno soils are similar to the Waukena, except that a lime-silica cemented hardpan occurs at a depth of 12 to 26 inches and the B_2 horizon has only a moderate prismatic structure. In many places the vesicular surface horizon is 2 to 4 inches thick.

The Lewis soils are similar to the Waukena, except that a lime-silica cemented hardpan, 4 to 10 inches thick, occurs at a depth of 30 to 42 inches. The parent material is medium textured and consists of a mixture of alluvium from granitic, metasedimentary, and metaigneous sources.

The Traver soils are well-drained, minimal Solonetz soils. The A horizon is weakly granular when moist but hard and massive when dry. The B_2 horizon has a weak blocky structure and is slightly finer textured than the A horizon. The parent material is moderately coarse textured alluvium from dominantly granitic sources.

Humic Gley soils

Humic Gley soils have been defined as a group of poorly to very poorly drained hydromorphic soils that have dark-colored, organic-mineral horizons of moderate thickness underlain by mineral gley horizons (*26*). A gley horizon is described as one in which the material ordinarily is bluish gray or olive gray, more or less sticky, compact, and often structureless and that developed under the influence of excessive moistening (*28*).

Nine series in the Merced Area have the characteristics of this group: Grangeville, Foster, Pozo, Temple, Landlow, Burchell, Bear Creek, Merced, and Alamo. Soils of these series occur in poorly drained basin areas or on flood plains that have slow external drainage and are affected by a high water table for part of the year. The vegetation generally consists of a dense growth of grasses and some sedges and reeds.

The Merced soils are representative of this group. They are in poorly drained areas on the San Joaquin River flood plain. They are flooded late in spring. The floodwater is slow moving and drains away slowly. A high water table persists through most of the summer and recedes gradually until the winter rains begin. The parent material is medium textured or moderately coarse textured alluvium derived from various igneous rocks, a large proportion of which are granitic.

A representative profile of Merced clay loam is as follows:

A_1 0 to 14 inches, clay loam; very dark gray (10YR 3/1) when dry, black (10YR 2/1) when moist; strong, medium, blocky structure; when thoroughly dry, the soil cracks into an irregular pattern of "adobe" blocks that are about 1 foot across and are separated by cracks about an inch wide; very hard when dry, firm when moist, sticky and plastic when wet; roots are most common in seams and cracks; mildly alkaline at the surface, increasingly alkaline with depth, pH 7.4 to 8.1; gradual, smooth boundary.

B_{2ca} 14 to 25 inches, clay; dark gray (10YR 4/1) when dry, very dark gray (10YR 3/1) when moist; moderate, coarse, blocky structure; thin, nearly continuous clay films on blocks; very hard when dry, very firm when moist, plastic and very sticky when wet; contains numerous roots, mainly in cracks; pH 8.1, moderately calcareous, contains considerable light-colored segregated lime; gradual, smooth boundary.

B_{3gcal} 25 to 43 inches, sandy clay; olive brown (2.5Y 4/4) when dry, dark grayish brown (10YR 4/2) when moist; weak, coarse, blocky structure; thin, patchy clay films on blocks; very hard when dry, very firm when moist, plastic and sticky when wet; contains a very few roots in seams; pH 8.1, moderately calcareous, contains light-colored segregated lime; gradual, smooth boundary.

B_{3gc} 43 to 59 inches, sandy clay loam; light yellowish brown (2.5Y 6/4) when dry, light olive brown (2.5Y 5/4) with common, fine, prominent mottles of strong brown (7.5YR 5/6) when moist; weak, coarse, blocky structure; thin, very patchy clay films on blocks; hard when dry, firm when moist, slightly plastic and slightly sticky when wet; pH 8.2, moderately calcareous, contains lime segregated in light-colored blotches and small nodules; gradual, smooth boundary.

C_g 59 to 75 inches, sandy loam; light yellowish brown (2.5Y 6/4) when dry, light olive brown (2.5Y 5/4) with common, fine, prominent mottles of strong brown (7.5YR 5/6) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; pH 7.8, very slightly calcareous.

The Grangeville series consists of imperfectly drained soils developed in moderately coarse textured granitic alluvium. They are grayish brown and mildly alkaline in the upper part of the A horizon, light grayish brown and mottled in the lower part of the A horizon, and pale brown, mottled, and strongly alkaline in the C horizon. In most places pumping has lowered the water table, but occasionally the soils are flooded.

The Foster soils are similar to the Grangeville soils, but they occur in depressions and old oxbows and are affected continuously by a high water table. The soils are poorly drained and very poorly drained, dark colored, and mottled throughout with light-gray, strong-brown, and bluish shades. They are intermittently calcareous. Generally they contain salts, particularly around the margins of the depressions. Water stands on the surface for several months in the winter and spring. Cattails and sedges commonly grow in the wetter areas.

Several factors appear to have influenced the development of the Pozo soils. These soils have a dark-gray A horizon overlying a thin, strongly cemented, lime-silica hardpan. They are affected by summer floods from the San Joaquin River. The flooding has produced a dense cover of grasses and lippia, has added a little sediment, and has leached the upper part of the older soil. Thus there is a relatively young Humic Gley soil developing in the upper part of a Calcisol.

The Temple soils are associated with the Merced soils on the San Joaquin River flood plain. They have a weak blocky B_2 horizon that contains slightly more clay than the A horizon. They also have a weak zone of accumulated lime in the lower part of the solum. The parent material consists of stratified, moderately coarse textured to moderately fine textured, granitic sediments.

The Landlow series consists of weakly developed Humic Gley soils that formed in moderately fine textured alluvium derived from basic igneous rocks. The A horizon ranges in texture from silt loam to clay. The coarser textures are a result of stratification. The B_2 horizon is generally calcareous clay. It tends to have weak, prismatic structure. A weak zone of lime accumulation is present in the lower B and upper C horizons; the C horizon is weakly lime cemented at a depth of about 4 feet. The upper part of the profile is dark grayish brown. It grades into light grayish-brown parent material.

The Burchell soils developed in medium textured to moderately coarse textured alluvium derived from metamorphosed basic igneous rocks. The B_2 horizon is weakly developed. The A horizon is dark grayish-brown silt loam and silty clay loam and is about neutral in reaction. The B horizon is generally grayish brown, slightly calcareous silty clay loam. It grades into grayish-brown, stratified silt loam and fine sandy loam, which is a slightly calcareous C horizon.

The Bear Creek soils are intermediate in characteristics between Noncalcic Brown and Humic Gley soils. They are imperfectly to moderately well drained, have a dark-gray A horizon that is moderately low in organic matter, and a slightly acid reaction. The texture varies, but loam and clay loam predominate. The B_2 horizon is grayish brown, mottled, slightly acid, and slightly finer textured than the A horizon. An unrelated, impervious substratum occurs at a moderate depth.

The Alamo soils are medial Humic Gley soils with a hardpan. They formed in depressions among hardpan soils of the San Joaquin and Madera series. The A horizon is gray to dark-gray clay. It overlies a gray to dark-gray B horizon that has a strong, coarse, blocky structure. The lower inch or two of the B_2 horizon is mottled. At a depth of 12 to 18 inches, the B_2 horizon rests directly on an iron-silica cemented hardpan that contains some lime in seams. The reaction is slightly acid to neutral, and the soil becomes more alkaline with depth. The soil is ponded during the rainy season. It remains moist until late in the spring, but it is dry during the summer and fall.

Humic Gley soils with solonetzic properties

This group of soils has properties of both the Humic Gley and Solonetz great soil groups. In the Merced Area only one representative, the Rossi series, is present. The soils of this series developed from moderately fine textured and fine textured alluvium of mixed, but dominantly granitic, origin. They are poorly drained or imperfectly drained and have a seasonally high water table. They are strongly alkaline throughout, gleyed, and have a moderately blocky and weakly prismatic B horizon. A description of a typical profile observed in the southwestern corner of sec. 33, T. 8 S., R. 12 E. follows:

A_1 0 to 5 inches, clay loam; gray (10YR 5/1) when dry, very dark gray (10YR 3/1) when moist; strong, coarse, blocky structure; very hard when dry, firm when moist, plastic and sticky when wet; high in organic matter; contains numerous roots and fine pores; pH 8.5, slightly calcareous; clear, smooth boundary.

B_{2g} 5 to 20 inches, clay; olive gray (5Y 5/2) when dry, olive (5Y 4/3) when moist; a few, fine, distinct mottles of strong brown (7.5YR 5/6); moderate, medium, subangular blocky structure with a weak tendency toward prismatic structure; moderately thick, nearly continuous clay films on blocks or prisms; very hard when dry, firm when moist, very plastic and very sticky when wet; a few saltgrass stolons penetrate along the cracks; pH 9.0, moderately calcareous, lime in root channels and segregated into small nodules that are much more numerous with increasing depth; gradual boundary.

B_{3gca} 20 to 50 inches, sandy clay loam; light gray (5Y 7/2) when dry, light olive gray (5Y 6/2) with a few, fine, distinct mottles of strong brown (7.5YR 5/6 and 7.5YR 5/8) when moist; weak, medium, subangular blocky structure; thin, patchy clay films on blocks; very hard when dry, firm when moist, plastic and sticky when wet; pH 9.0, strongly calcareous, lime segregated into hard, light-colored nodules and soft masses; clear, smooth boundary.

C_g 50 inches +, somewhat stratified fine sandy loam; light yellowish brown (2.5Y 6/4) when dry, light olive brown (2.5Y 5/4) with many, medium and fine, distinct mottles of strong brown (7.5YR 5/6) when moist; massive; hard when dry, friable when moist, slightly plastic and slightly sticky when wet; pH 8.5, moderately calcareous, the lime mostly disseminated; several feet thick.

Calcium Carbonate Solonchaks

Calcium Carbonate Solonchaks are characterized by a dark-colored A horizon and a distinct zone of lime accumulation in the lower part of the A horizon or immediately below it (*15*). These soils developed under the influence of a high or intermittently high water table. The Piper series is the only representative of this great soil group in the Merced Area. It consists of imperfectly drained soils developed in moderately coarse textured mixed alluvium of dominantly granitic origin. A typical profile, Piper fine sandy loam, occurs three quarters of a mile west and half a mile north of the Turner Ranch headquarters in T. 9 S., R. 11 E. It is described as follows:

A_1 0 to 6 inches, fine sandy loam; grayish brown (10YR 5/2) when dry, very dark grayish brown (10YR 3/2) when moist; essentially massive when dry, and weak, very fine, granular structure when moist; hard when dry, very friable when moist; moderate in organic matter; contains numerous fine root hairs and very fine pores; pH 7.2, moderately to strongly calcareous; clear, smooth boundary.

C_{ca1} 6 to 18 inches, fine sandy loam; light brownish gray (10YR 6/2) when dry, grayish brown (10YR 5/2), light gray (10YR 7/1), and gray (10YR 6/1) when moist, in a variable, fine, indistinct pattern apparently due to finely disseminated and segregated lime; massive; hard when dry, very friable when moist; finely porous; low in organic matter; contains a few fine roots; pH 7.9; gradual, smooth boundary.

C_{ca2g} 18 to 36 inches, fine sandy loam; light gray (2.5Y 7/2) when dry, grayish brown (2.5Y 5/2) with a few, fine, faint mottles of yellowish brown (10YR 5/6 and 10YR 5/8) when moist; massive; slightly hard to hard when dry, very friable when moist; very low in organic matter; pH 8.5, strongly calcareous; gradual, smooth boundary.

C_{ca3g} 36 to 50 inches, sandy loam; light brownish gray (2.5Y 6/2) when dry, grayish brown (2.5Y 5/2) with a few, fine, faint mottles of yellowish brown (10YR 5/6 and 10YR 5/8) when moist; massive; very hard when dry, firm when moist; pH 8.4, strongly calcareous, contains whitish segregations of hardened lime; gradual, smooth boundary.

C_g 50 to 60 inches, sandy loam; light yellowish brown (2.5Y 6/3) when dry, light olive brown (2.5Y 4.5/3) with a few, fine, faint mottles of brown to yellowish brown when moist; massive; hard when dry, very friable when moist; pH 8.2, very slightly calcareous.

TABLE 10.—*Mechanical analyses of representative soil samples from the Merced Area, California*

[Where no figures are given, data were not determined]

Soil	Depth	Sand [1]					Total sand (2–0.05 mm.)	Silt [2] (0.05–0.002 mm.)	Clay [3] (less than 0.002 mm.)
		Very coarse (2–1 mm.)	Coarse (1–0.5 mm.)	Medium (0.5–0.25 mm.)	Fine (0.25–0.10 mm.)	Very fine (0.10–0.05 mm.)			
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Greenfield sandy loam, deep over hardpan	0 to 13	4	25	17	18	12	76	18	6
	13 to 25	5	19	24	18	10	76	16	8
	25 to 37½	4	23	16	11	15	69	18	13
	37½ to 41	4	13	14	10	6	47	23	30
	41 to 48	(Hardpan)							
	48 to 72	4	22	16	17	10	69	10	21
	72 to 94	5	17	20	17	10	69	15	16
Hopeton clay loam	0 to 2½	2	4	5	14	14	39	37	24
	2½ to 16								
	16 to 24	1	2	4	10	9	26	28	46
	24 to 42								
	42 to 66	1	2	8	25	14	50	33	17
Hornitos fine sandy loam	0 to 1	5	5	5	29	19	63	26	11
	1 to 7	2	4	5	32	19	62	26	12
	7 to 10	(Bedrock)							
Montpellier coarse sandy loam	0 to 8	10	16	17	14	9	66	24	10
	8 to 20	9	15	17	14	10	65	24	11
	20 to 23	10	16	16	14	10	66	24	10
	23 to 31	8	13	15	14	9	59	23	18
	31 to 55	6	12	14	15	10	57	20	23
	55 to 62	6	10	16	21	12	65	15	20
Pachappa sandy loam	0 to 16	5	10	17	28	16	76	17	7
	16 to 24	3	11	12	28	15	69	14	17
	24 to 30								
	30 to 55	6	12	20	31	12	81	12	7
Redding gravelly loam	0 to 3	7	10	7	11	12	47	36	17
	3 to 8	4	8	10	12	12	46	35	19
	8 to 13	4	10	7	11	11	43	34	23
	13 to 19	6	5	6	6	5	28	16	56
	19 to 21	8	10	4	1	9	32	10	58
	21 to 35	(Hardpan)							
Rocklin loam	0 to 7	0	1	3	8	34	46	37	17
	7 to 16	0	1	3	8	36	48	34	18
	16 to 24	0	2	3	9	32	46	36	18
	24 to 28	1	1	4	9	33	48	34	18
	28 to 30	(Hardpan)							
Ryer silt loam	0 to 10	3	5	4	6	6	24	56	20
	10 to 20	1	5	4	7	6	23	54	23
	20 to 32	1	2	4	6	4	17	44	39
	32 to 44	1	2	3	4	4	14	51	35
	44 to 54	1	3	5	6	4	19	49	32
	54 to 64	1	5	5	7	4	22	48	30
	64 to 84	2	6	9	10	6	33	41	26
San Joaquin sandy loam	0 to 9	5	8	13	16	15	57	28	15
	9 to 13	6	12	10	15	18	61	23	16
	13 to 17½	5	11	9	15	13	53	29	18
	17½ to 20½	5	7	12	15	13	52	28	20
	20½ to 25	2	5	5	7	6	25	11	64
	25 to 27	(Hardpan)							
	27 to 40	12	12	11	17	16	68	18	14
	40 to 50	6	13	10	17	12	58	24	18

[1] Sand content determined by wet sieving.
[2] Silt content determined by difference between 100 and clay plus sand.
[3] Clay content determined by Bouyoucos hydrometer.

TABLE 10.—*Mechanical analyses of representative soil samples from the Merced Area, California*—Continued

[Where no figures are given, data were not determined]

Soil	Depth	Sand [1] Very coarse (2–1 mm.)	Coarse (1–0.5mm.)	Medium (0.5–0.25 mm.)	Fine (0.25–0.10 mm.)	Very fine (0.10–0.05 mm.)	Total sand (2–0.05 mm.)	Silt [2] (0.05–0.002 mm.)	Clay [3] (less than 0.002 mm.)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Snelling sandy loam	0 to 4	5	23	17	17	11	73	22	5
	4 to 16	4	18	25	18	10	75	16	9
	16 to 25	4	18	24	18	8	72	17	11
	25 to 37	5	17	22	15	9	68	16	16
	37 to 49	3	21	15	16	9	64	17	19
	49 to 80	5	17	23	18	7	70	10	20
Whitney fine sandy loam	0 to 6	1	6	7	22	26	62	22	16
	6 to 11	1	5	12	22	23	63	19	18
	11 to 15	1	7	10	24	22	64	16	20
	15 to 26	1	3	14	31	21	70	10	20
Wyman clay loam	0 to 5	1	1	2	8	11	23	51	26
	5 to 14	0	1	2	6	12	21	49	30
	14 to 30	0	1	2	7	13	23	45	32
	30 to 41	0	1	1	5	7	14	52	34

See footnotes on page 120.

TABLE 11.—*The pH, $CaCO_3$ equivalent, moisture equivalent, and organic-matter content of representative soil samples from the Merced Area, California*

[Where no figures are given, data were not determined]

Soil	Depth	pH [1]	$CaCO_3$ equivalent [2]	Moisture equivalent [3]	Organic matter [4]
	Inches		*Percent*	*Percent*	*Percent*
Alamo clay	0 to 6	6.1		21.2	
	6 to 16	5.9		31.5	
	16 to 18	6.7		24.9	
	18 to 24	(Hardpan)			
Amador loam	0 to 3	5.3		22.2	1.45
	3 to 10	4.8		20.0	.69
	10 to 13	(Bedrock)			
Anderson gravelly sandy loam	0 to 3	6.0		11.0	
	3 to 11	5.5		14.6	
	11 to 24	5.5		13.8	
Atwater loamy sand	0 to 27	7.0		3.4	
	27 to 36	6.7		8.8	
	36 to 60	6.9		8.0	
Bear Creek loam	0 to 8	6.1		19.5	
	8 to 15	6.5		17.1	
	15 to 24	6.4		18.3	
	24 to 30	6.3		21.8	
	30 to 50	7.6		20.6	
Borden fine sandy loam	0 to 11	7.0		11.1	1.60
	11 to 13	7.8		13.0	1.77
	13 to 19	7.7		18.1	.53
	19 to 36	8.6	0.8	21.4	.34
	36 to 46	8.8	3.4	19.4	.08
	46 to 70	8.8	2.6	15.7	.21
Burchell silty clay loam, slightly saline-alkali	0 to 8	6.9		25.9	
	8 to 16	9.5	.4	37.8	
	16 to 27	9.6	.5	29.8	
	27 to 46	9.3	1.6	34.6	
	46 to 66	8.8		14.3	

[1] pH at saturation, using Beckman glass electrode pH meter.
[2] By Williams method; carbonates measured by CO_2 pressure produced.
[3] Percentage of water retained when saturated soil is subjected to 1000 g. in a centrifuge.
[4] By dry combustion.

TABLE 11.—*The pH, $CaCO_3$ equivalent, moisture equivalent, and organic-matter content of representative soil samples from the Merced Area, California*—Continued

Soil	Depth	pH [1]	$CaCO_3$ equivalent [2]	Moisture equivalent [3]	Organic matter [4]
	Inches		*Percent*	*Percent*	*Percent*
Columbia fine sandy loam	0 to 5	6.4		16.6	
	5 to 13	5.8		15.6	
	13 to 24	5.7		30.4	
	24 to 36	5.7		31.1	
	36 to 53	5.9		32.2	
	53 to 60	6.5		27.0	
Corning gravelly loam	0 to 1	6.1		17.4	3.25
	1 to 11	6.1		15.4	.88
	11 to 19	5.0		23.5	.84
	19 to 30	4.9		21.5	.34
	30 to 48	5.0		19.5	.20
	48 to 58	6.2		19.0	.20
Daulton rocky silt loam	0 to 3	5.6		24.8	3.24
	3 to 11	5.7		21.2	1.25
	11 to 18+	(Bedrock)			
Delhi sand	0 to 12	6.5		2.5	
	12 to 44	6.5		1.9	
	44 to 68	6.4		2.1	
Delhi sand, silty substratum	0 to 5	7.1	<0.1	2.9	
	5 to 13	6.6		3.6	
	13 to 27	6.0		4.8	
	27 to 42	6.9		16.7	
	42 to 50	7.3	<0.1	4.5	
	50 to 72	8.3	<0.1	3.6	
Dello sand, poorly drained	0 to 1½	5.8		5.0	
	1½ to 8	6.1		3.3	
	8 to 19	6.6		3.0	
	19 to 31	6.7		3.0	
Exchequer rocky silt loam	0 to 1½	6.3		22.5	2.46
	1½ to 10	6.1		19.9	.72
	10 to 13+	(Bedrock)			
Fresno loam	0 to 2½	6.8		21.5	
	2½ to 5	6.9		22.6	
	5 to 9	8.5	1.1	26.8	
	9 to 17	9.9	3.1	27.4	
	17 to 26	9.6	3.0	31.7	
	26 to 33	9.0	11.7	(Hardpan)	
	33 to 56	9.75	1.5		
Grangeville fine sandy loam	0 to 11	8.7	1.3	23.6	
	11 to 17	8.9	1.2	21.7	
	17 to 29	8.2	<0.1	19.0	
	29 to 46	7.3		17.5	
	46 to 60	6.9		13.8	
Greenfield sandy loam, deep over hardpan	0 to 13	6.2		6.9	
	13 to 25	6.0		6.6	
	25 to 37½	5.6		9.4	
	37½ to 41	6.4		16.0	
	41 to 48	(Hardpan)			
	48 to 72	7.4	<0.1		
	72 to 94	6.7			
Hanford sandy loam	0 to 12	7.4		10.2	
	12 to 60	7.5		9.6	
Hilmar loamy sand	0 to 5	7.8		5.3	
	5 to 23	10.1	.2	4.8	
	23 to 35	10.2	6.3	16.7	
Honcut silt loam	0 to 5	6.5		17.6	
	5 to 13	6.7		15.2	
	13 to 26	6.7		15.8	

See footnotes on page 121.

TABLE 11.—*The pH, $CaCO_3$ equivalent, moisture equivalent, and organic-matter content of representative soil samples from the Merced Area, California*—Continued

Soil	Depth	pH [1]	$CaCO_3$ equivalent [2]	Moisture equivalent [3]	Organic matter [4]
	Inches		*Percent*	*Percent*	*Percent*
Hopeton clay loam	0 to 2½	6.0		18.5	1.58
	2½ to 6	5.8		21.5	.83
	6 to 16	5.7		29.9	.64
	16 to 24	6.3		30.6	.60
	24 to 32	7.1		32.6	.40
	32 to 42	7.6		28.4	.25
	42 to 66	7.2			.14
Hornitos fine sandy loam	0 to 1	5.3		19.0	3.34
	1 to 7	5.2		13.7	.86
	7 to 10+	(Bedrock)			
Landlow clay	0 to 2	6.8		29.6	
	2 to 11	8.0		52.5	
	11 to 17	8.6	1.78	58.8	
	17 to 30	9.0	2.44	49.7	
	30 to 60	8.3	5.50	28.1	
	60 to 80	8.1	3.80	28.1	
Lewis silty clay loam	0 to 6	8.0	.4	37.1	
	6 to 14	9.4	3.1	53.5	
	14 to 25	9.2	3.2	48.5	
	25 to 31	9.0	4.7	46.0	
	31 to 35	9.1	9.9	(Hardpan)	
	35 to 60	8.2	10.2	26.4	
Madera sandy loam	0 to 6	6.4		12.8	
	6 to 23	6.0		12.4	
	23 to 28	6.3		13.1	
	28 to 30	6.4	(Hardpan)		
	30 to 37	7.8	(Hardpan)		
	37 to 60	7.9	.1		
Madera loam	0 to 7½	5.9		14.9	
	7½ to 11	6.3		18.2	
	11 to 18	6.6		24.2	
	18 to 26	(Hardpan)			
Marguerite loam	0 to 4	6.4		18.9	
	4 to 10½	6.5		17.1	
	10½ to 20	7.0		17.6	
	20 to 30	7.1		17.6	
	30 to 60	7.0		17.2	
Merced silt loam, overwashed	0 to 5	5.9		42.0	
	5 to 10	6.4		25.3	
	10 to 19	7.4		21.1	
	19 to 30	8.1	2.8	18.8	
	30 to 39	8.1	1.2	18.4	
	39 to 48	8.2	1.3	19.9	
	48 to 64	8.1	2.7	17.9	
	64 to 78	7.8	0	5.4	
Montpellier coarse sandy loam	0 to 8	6.0		9.5	.31
	8 to 20	5.8		8.9	.27
	20 to 23	5.9		9.6	.25
	23 to 31	6.0		12.5	.18
	31 to 55	5.6		15.8	.20
	55 to 62	5.8		14.9	.16
Pachappa sandy loam	0 to 16	6.3		9.4	
	16 to 24	6.6		13.3	
	24 to 30	7.9	1.2	11.2	
	30 to 55	8.2	.7	8.0	
Pentz gravelly loam	0 to 2	6.1		16.4	2.05
	2 to 10	6.1		14.7	.78
	10 to 14+	(Bedrock)			
Peters cobbly clay	0 to 4	6.2		29.5	3.00
	4 to 14	6.3		34.5	1.03
	14 to 16+	(Bedrock)			

See footnotes on page 121.

TABLE 11.—*The pH, $CaCO_3$ equivalent, moisture equivalent, and organic-matter content of representative soil samples from the Merced Area, California*—Continued

Soil	Depth	pH [1]	$CaCO_3$ equivalent [2]	Moisture equivalent [3]	Organic matter [4]
	Inches		*Percent*	*Percent*	*Percent*
Piper fine sandy loam	0 to 6	7.2	5.7	17.2	
	6 to 18	7.9	9.5	16.5	
	18 to 36	8.5	11.2	14.9	
	36 to 50	8.4	13.0	15.6	
	50 to 60	8.2	<0.1	9.2	
Porterville clay	0 to 2	7.3		36.2	
	2 to 13	7.7		35.5	
	13 to 22	8.1	<0.1	36.0	
	22 to 48	8.2	.3	44.3	
	48 to 72	8.3	.8	50.2	
Raynor clay	0 to 16	6.7		34.5	.72
	16 to 33	7.7	<0.1	36.8	.37
	33 to 48	7.8	3.0	42.1	.48
Redding gravelly loam	0 to 3	5.4		15.6	1.91
	3 to 8	5.3		14.0	.78
	8 to 13	5.4		15.1	.60
	13 to 19	5.3		41.4	.66
	19 to 21	5.4		42.0	.77
	21 to 35	(Hardpan)			
Rocklin loam	0 to 7	6.1		14.9	1.10
	7 to 16	5.7		14.5	.71
	16 to 24	6.2		14.4	.55
	24 to 28	6.8		15.1	.46
	28 to 30	(Hardpan)			
Rossi clay	0 to 9	8.9	1.5	60.1	
	9 to 24	9.9	7.4	55.6	
	24 to 43	9.9	7.4	50.7	
	43 to 60	9.5	8.9	49.8	
Ryer silt loam	0 to 10	5.7		20.7	
	10 to 20	5.7		19.6	
	20 to 32	6.2		22.7	
	32 to 44	7.3		23.5	
	44 to 54	7.8	<0.1	24.0	
	54 to 64	7.7		23.5	
	64 to 84	6.7		21.3	
San Joaquin sandy loam	0 to 9	5.9		12.9	
	9 to 13	5.7		12.4	
	13 to 17½	6.1		12.4	
	17½ to 20½	6.3		12.9	
	20½ to 25	6.3		34.6	
	25 to 27	7.0	(Hardpan)		
	27 to 40	7.9	.2	(Hardpan)	
	40 to 50	7.9			
Sesame rocky loam	0 to ¾	6.2			9.47
	¾ to 8	6.1		15.9	1.22
	8 to 14	6.1		17.9	.55
Seville clay	0 to 5½	7.7	.7	30.1	
	5½ to 11	7.7	2.7	29.0	
	11 to 18	7.8	3.4	30.6	
	18 to 20	7.8	4.5	31.0	
	20 to 23	8.0	17.6	(Hardpan)	
	23 to 42	8.7	2.7		
	42 to 60	8.7	4.0		
Snelling sandy loam	0 to 4	6.6		9.0	1.27
	4 to 16	6.3		7.4	.49
	16 to 25	6.1		8.0	.35
	25 to 37	5.9		9.8	.20
	37 to 49	5.9		10.9	.17
	49 to 80	6.1		10.5	.20

See footnotes on page 121.

TABLE 11.—*The pH, $CaCO_3$ equivalent, moisture equivalent, and organic-matter content of representative soil samples from the Merced Area, California*—Continued

Soil	Depth	pH [1]	$CaCO_3$ equivalent [2]	Moisture equivalent [3]	Organic matter [4]
	Inches		*Percent*	*Percent*	*Percent*
Temple loam	0 to 8	5.3		32.1	
	8 to 12	6.2		24.0	
	12 to 25	7.6	0.2	21.1	
	25 to 30	8.0	7.0	19.7	
	30 to 49	8.2	6.1	20.2	
Traver fine sandy loam	0 to 4	7.9	<0.1	21.6	
	4 to 18	9.6	.9	23.8	
	18 to 34	10.3	1.0	19.9	
	34 to 54	9.9	.8	22.6	
Tujunga sand	0 to 12	6.0		4.9	
	12 to 36	6.5		2.7	
	36 to 60	6.7		1.9	
Waukena fine sandy loam	0 to 10	7.6		9.4	
	10 to 18	9.3	2.0	16.1	
	18 to 27	10.0	1.2	25.0	
	27 to 39	9.9	1.0	20.9	
Whitney fine sandy loam	0 to 6	6.5		13.9	1.57
	6 to 11	6.4		13.2	.67
	11 to 15	6.3		14.3	.58
	15 to 26	6.3		15.6	.34
Wyman clay loam	0 to 5	6.5		23.7	
	5 to 14	6.6		22.6	
	14 to 30	6.8		23.7	
	30 to 41	7.0		27.6	
Wyman loam	0 to 11	6.6		22.3	
	11 to 23	7.3	<0.1	23.4	
	23 to 36	7.7		24.2	
	36 to 48	7.8	.9	24.4	
	48 to 60	7.8	.3	25.0	
Yokohl loam	0 to 4	7.1		19.8	
	4 to 10	6.9		19.0	
	10 to 21	7.2		24.7	
	21 to 31	8.2	.8		
	31 to 41	8.2	6.8		
	41 to 66	8.0	3.9		
Yolo loam	0 to 13	6.3		16.6	
	13 to 25	6.8		14.1	
	25 to 50				

See footnotes on page 121.

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GUIDE TO MAPPING UNITS AND CAPABILITY UNITS

[See table 5, p. 24, for approximate acreage and proportionate extent of soils; table 6, p. 76, for the Storie index rating of each soil; and table 7, p. 85, for the relative suitability of each soil for the principal crops of the Area]

Map symbol	*Mapping unit*	*Page*	*Capability unit*	*Page*
AaA	Alamo clay, 0 to 1 percent slopes	27	IIIw-5	99
AbB	Amador loam, 0 to 8 percent slopes	28	VIIe-9	105
AbD	Amador loam, 8 to 30 percent slopes	28	VIIe-9	105
AbE	Amador loam, 30 to 45 percent slopes	28	VIIe-9	105
AcA	Anderson gravelly soils, channeled, 0 to 3 percent slopes	29	VIIe-3	105
AdA	Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes.	30	IVw-4	102
AfA	Atwater loamy sand, 0 to 3 percent slopes	30	IIe-4	95
AfB	Atwater loamy sand, 3 to 8 percent slopes	30	IIe-4	95
AgA	Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes	30	IIIe-4	98
AgB	Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes	31	IIIe-4	98
AkA	Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes	30	IIIw-4	99
AnA	Atwater sand, 0 to 3 percent slopes	29	IIIe-4	98
AnB	Atwater sand, 3 to 8 percent slopes	30	IIIe-4	98
ArB	Auburn rocky silt loam, 3 to 8 percent slopes	31	VIIe-3	105
BaA	Bear Creek clay loam, 0 to 3 percent slopes	32	IIIw-2	99
BcA	Bear Creek loam, 0 to 3 percent slopes	31	IIIw-2	99
BdA	Bear Creek soils, 0 to 3 percent slopes	32	VIIe-3	105
BeA	Borden fine sandy loam, 0 to 3 percent slopes	32	IIs-7	98
BfA	Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	32	IIIs-6	100
BgA	Burchell silt loam, 0 to 1 percent slopes	33	IIw-2	96
BkA	Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes	33	IIw-2	96
BmA	Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes	33	IIIw-6	100
BnA	Burchell silty clay loam, 0 to 1 percent slopes	33	IIw-2	96
BpA	Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	33	IIw-2	96
BrA	Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	33	IIIw-6	100
CaA	Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes.	34	IIw-2	96
CbA	Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes	34	IIw-3	96
CcA	Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes	34	IIw-2	96
CeA	Columbia soils, channeled, 0 to 3 percent slopes	34	IIIe-4	98
CfB	Corning cobbly loam, 3 to 8 percent slopes	36	VIe-9	104
CfD	Corning cobbly loam, 8 to 30 percent slopes	36	VIe-9	104
CgB	Corning gravelly loam, 0 to 8 percent slopes	35	IVe-3	101
CgD	Corning gravelly loam, 8 to 30 percent slopes	35	VIe-9	104
CgD2	Corning gravelly loam, 8 to 30 percent slopes, eroded	35	VIe-9	104
CgE2	Corning gravelly loam, 30 to 45 percent slopes, eroded	36	VIIe-9	105
CkB	Corning gravelly sandy loam, 0 to 8 percent slopes	35	IVe-3	101
CkD	Corning gravelly sandy loam, 8 to 30 percent slopes	35	VIe-9	104
CkD2	Corning gravelly sandy loam, 8 to 30 percent slopes, eroded	35	VIe-9	104
CkE2	Corning gravelly sandy loam, 30 to 45 percent slopes, eroded	35	VIIe-9	105
DaB	Daulton rocky silt loam, 3 to 8 percent slopes	36	VIIe-3	105
DaD2	Daulton rocky silt loam, 8 to 30 percent slopes, eroded	36	VIIe-3	105
DbA	Delhi loamy fine sand, 0 to 3 percent slopes	37	IIIe-4	98
DbB	Delhi loamy fine sand, 3 to 8 percent slopes	37	IIIe-4	98
DcA	Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes	38	IIIe-4	98
DdA	Delhi loamy sand, 0 to 3 percent slopes	37	IIIe-4	98
DdB	Delhi loamy sand, 3 to 8 percent slopes	37	IIIe-4	98
DeA	Delhi loamy sand, silty substratum, 0 to 3 percent slopes	38	IIIe-4	98
DfA	Delhi sand, 0 to 3 percent slopes	36	IVe-4	101
DfB	Delhi sand, 3 to 8 percent slopes	37	IVe-4	101
DfC	Delhi sand, 8 to 15 percent slopes	37	IVe-4	101
DgA	Delhi sand, silty substratum, 0 to 3 percent slopes	37	IIIe-4	98
DgB	Delhi sand, silty substratum, 3 to 8 percent slopes	38	IIIe-4	98
DhA	Dello loamy fine sand, 0 to 1 percent slopes	38	IIIw-4	99
DkA	Dello sand, 0 to 1 percent slopes	38	IIIw-4	99
DmA	Dello sand, poorly drained, 0 to 1 percent slopes	38	IVw-4	102
DnA	Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes	38	IVw-4	102
DoA	Dello sand, slightly saline-alkali, 0 to 1 percent slopes	38	IIIw-4	99
DpA	Dinuba sandy loam, 0 to 1 percent slopes	39	IIw-3	96
DrA	Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes	39	IIw-3	96
DsA	Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes.	39	IIIw-6	100

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GUIDE TO MAPPING UNITS AND CAPABILITY UNITS—Continued

Map symbol	Mapping unit	Page	Capability unit	Page
DtA	Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes.	39	IVw-6	102
DuA	Dune land, 0 to 3 percent slopes	39	IVe-4	101
DuB	Dune land, 3 to 8 percent slopes	40	IVe-4	101
EaD	Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes	40	VIIe-3	105
FaA	Foster fine sandy loam, 0 to 1 percent slopes	40	IIIw-2	99
FbA	Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes	41	VIw-6	105
FcA	Foster fine sandy loam, very poorly drained, slightly saline-alakli, 0 to 1 percent slopes.	41	VIw-6	105
FdA	Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	41	IIIw-2	99
FeA	Foster gravelly fine sandy loam, 0 to 1 percent slopes	41	VIw-6	105
FfA	Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes	42	IIIs-8	100
FgA	Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes	42	IVs-8	103
FkA	Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes	42	VIs-8	105
FmA	Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes.	42	VIs-8	105
FnA	Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes.	42	VIs-8	105
FoA	Fresno loam, poorly drained variant, strongly saline-alkali, 0 to 1 percent slopes.	42	VIs-8	105
FpA	Fresno loam, slightly saline-alkali, 0 to 1 percent slopes	41	IIIs-8	100
FrA	Fresno loam, moderately saline-alkali, 0 to 1 percent slopes	42	IVs-8	103
FsA	Fresno loam, strongly saline-alkali, 0 to 1 percent slopes	42	VIs-8	105
GaA	Grangeville fine sandy loam, 0 to 1 percent slopes	43	IIw-2	96
GbA	Grangeville loam, 0 to 1 percent slopes	43	IIw-2	96
GcA	Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes	43	IIw-2	96
GdA	Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes	43	IIIw-6	100
GeA	Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes.	44	IIIw-2	99
GfA	Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes	44	IIs-3	97
GfB	Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes	44	IIs-3	97
GfB3	Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied.	44	IVe-3	101
HaA	Hanford fine sandy loam, 0 to 1 percent slopes	45	I-1	95
HbA	Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes.	45	IIe-4	95
HcB	Hanford fine sandy loam, channeled, 0 to 8 percent slopes	45	IIe-1	95
HdA	Hanford gravelly sandy loam, 0 to 1 percent slopes	45	IIs-4	97
HeA	Hanford sandy loam, 0 to 1 percent slopes	44	I-1	95
HfA	Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes.	46	IVw-4	102
HgA	Hilmar loamy sand, 0 to 3 percent slopes	45	IIIw-4	99
HhA	Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes	46	IIIw-4	99
HkA	Hilmar sand, poorly drained, 0 to 1 percent slopes	46	IVw-4	102
HmA	Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes.	47	VIw-4	104
HnA	Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes	47	VIw-4	104
HoA	Hilmar sand, 0 to 3 percent slopes	46	IIIw-4	99
HpA	Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes	46	IIIw-4	99
HrA	Honcut fine sandy loam, 0 to 1 percent slopes	47	I-1	95
HsA	Honcut gravelly sandy loam, 0 to 1 percent slopes	48	IIs-4	97
HtA	Honcut silt loam, 0 to 1 percent slopes	47	I-1	95
HuA	Honcut silt loam, deep over hardpan, 0 to 1 percent slopes	47	IIs-3	97
HwA	Honcut silty clay loam, 0 to 1 percent slopes	48	I-1	95
HxA	Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes	48	IIs-3	97
HzA	Honcut silty clay loam, channeled, 0 to 8 percent slopes	48	IIe-1	95
2HB	Hopeton clay, 0 to 8 percent slopes	49	IIIs-5	100
3HA	Hopeton clay loam, 0 to 3 percent slopes	48	IVs-3	102
3HB	Hopeton clay loam, 3 to 8 percent slopes	49	IVe-3	101
3HC	Hopeton clay loam, 8 to 15 percent slopes	49	IVe-3	101
4HB	Hopeton gravelly clay loam, 0 to 8 percent slopes	49	IVe-3	101
5HB	Hornitos fine sandy loam, 3 to 8 percent slopes	49	VIIe-9	105
5HD	Hornitos fine sandy loam, 8 to 30 percent slopes	49	VIIe-9	105
5HE	Hornitos fine sandy loam, 30 to 45 percent slopes	49	VIIe-9	105
6HB	Hornitos gravelly fine sandy loam, 0 to 8 percent slopes	49	VIIe-9	105
6HD	Hornitos gravelly fine sandy loam, 8 to 30 percent slopes	50	VIIe-9	105
KaB	Keyes gravelly clay loam, 0 to 8 percent slopes	50	IVe-3	101
KbB	Keyes gravelly loam, 0 to 8 percent slopes	50	IVe-3	101
KbC	Keyes gravelly loam, 8 to 15 percent slopes	50	VIe-9	104
KcB	Keyes-Pentz gravelly loams, 0 to 8 percent slopes	50	VIe-9	104
LaA	Landlow clay, 0 to 1 percent slopes	51	IIIw-5	99
LbA	Landlow clay, slightly saline-alkali, 0 to 1 percent slopes	52	IIIw-5	99
LcA	Landlow silt loam, 0 to 1 percent slopes	51	IIIw-2	99
LdA	Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes	51	IIIw-6	100
LeA	Landlow silty clay loam, 0 to 1 percent slopes	51	IIIw-2	99

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS—Continued

Map symbol	Mapping unit	Page	Capability unit	Page
LfA	Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	51	IIIw-6	100
LgA	Lewis clay, slightly saline-alkali, 0 to 1 percent slopes	53	IVs-8	103
LhA	Lewis clay, moderately saline-alkali, 0 to 1 percent slopes	53	VIs-8	105
LkA	Lewis loam, slightly saline-alkali, 0 to 1 percent slopes	52	IIIs-8	100
LmA	Lewis loam, moderately saline-alkali, 0 to 1 percent slopes	52	IVs-8	103
LnA	Lewis loam, strongly saline-alkali, 0 to 1 percent slopes	52	VIs-8	105
LoA	Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	53	IIIs-8	100
LpA	Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	53	IVs-8	103
LrA	Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes	53	VIs-8	105
MaA	Madera fine sandy loam, 0 to 3 percent slopes	54	IVs-3	102
MbA	Madera loam, 0 to 1 percent slopes	54	IVs-3	102
McA	Madera loam, slightly saline-alkali, 0 to 1 percent slopes	54	IVs-3	102
MdA	Madera sandy loam, 0 to 3 percent slopes	53	IVs-3	102
MdB	Madera sandy loam, 3 to 8 percent slopes	54	IVe-3	101
MeA	Marguerite loam, 0 to 1 percent slopes	54	I-1	95
MfA	Marguerite silty clay loam, 0 to 1 percent slopes	54	I-1	95
MgA	Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes	55	IIs-3	97
MhA	Merced clay, slightly saline, 0 to 1 percent slopes	55	IIIw-5	99
MkA	Merced clay, moderately saline, 0 to 1 percent slopes	56	IIIw-5	99
MmA	Merced clay loam, slightly saline, 0 to 1 percent slopes	55	IIIw-2	99
MnA	Merced clay loam, moderately saline, 0 to 1 percent slopes	55	IIIw-6	100
MoA	Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes	55	VIw-6	105
MpA	Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes	55	IIw-2	96
MrA	Montpellier coarse sandy loam, 0 to 3 percent slopes	56	IVs-3	102
MrB	Montpellier coarse sandy loam, 3 to 8 percent slopes	56	IVe-3	101
MrC	Montpellier coarse sandy loam, 8 to 15 percent slopes	56	IVe-3	101
MrC2	Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded	56	VIe-9	104
MrD2	Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded	56	VIe-9	104
MrE2	Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded	56	VIIe-9	105
PaA	Pachappa fine sandy loam, 0 to 1 percent slopes	57	I-1	95
PbA	Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	57	IIs-6	97
PcA	Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes	57	IIs-3	97
PdA	Pachappa sandy loam, 0 to 1 percent slopes	57	I-1	95
PeA	Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes	57	IIs-6	97
PfA	Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.	57	IIs-3	97
PgA	Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes	57	IIs-3	97
PhB	Pentz clay loam, 0 to 8 percent slopes	58	VIIe-3	105
PhD	Pentz clay loam, 8 to 30 percent slopes	58	VIIe-3	105
PkB	Pentz gravelly loam, 0 to 8 percent slopes	58	VIIe-3	105
PkD	Pentz gravelly loam, 8 to 30 percent slopes	58	VIIe-3	105
PmB	Pentz loam, 0 to 8 percent slopes	58	VIIe-3	105
PmD	Pentz loam, 8 to 30 percent slopes	58	VIIe-3	105
PmE	Pentz loam, 30 to 75 percent slopes	58	VIIe-3	105
PnB	Peters clay, 0 to 8 percent slopes	59	IVe-5	102
PnC	Peters clay, 8 to 15 percent slopes	59	IVe-5	102
PoB	Peters cobbly clay, 0 to 8 percent slopes	59	VIe-5	104
PoD	Peters cobbly clay, 8 to 30 percent slopes	59	VIe-5	104
PpA	Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes	59	IIw-2	96
PsA	Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes	59	IIIw-6	100
PtA	Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes	59	IVw-6	102
PuA	Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes	60	VIw-6	105
Pv	Pits	60	VIIIs-1	106
PwA	Porterville clay, 0 to 3 percent slopes	60	IIIs-5	100
PwB	Porterville clay, 3 to 8 percent slopes	60	IIIs-5	100
PxA	Pozo clay loam, 0 to 1 percent slopes	60	IIIs-8	100
PyA	Pozo clay loam, slightly saline, 0 to 1 percent slopes	61	IIIs-8	100
PzA	Pozo clay loam, moderately saline, 0 to 1 percent slopes	61	IVs-8	103
RaA	Raynor clay, 0 to 3 percent slopes	61	IIIs-5	100
RaB	Raynor clay, 3 to 8 percent slopes	61	IIIs-5	100
RaC	Raynor clay, 8 to 15 percent slopes	61	IVe-5	102
RbA	Raynor cobbly clay, 0 to 3 percent slopes	61	VIe-5	104
RbB	Raynor cobbly clay, 3 to 8 percent slopes	62	VIe-5	104
RbC	Raynor cobbly clay, 8 to 15 percent slopes	62	VIe-5	104
RcB	Redding cobbly loam, 0 to 8 percent slopes	62	VIe-9	104
RdA	Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes	62	VIe-9	104
ReB	Redding gravelly loam, 0 to 8 percent slopes	62	IVe-3	101
ReD	Redding gravelly loam, 8 to 30 percent slopes	62	VIe-9	104
Rf	Riverwash	62	VIIIs-1	106
RgA	Rocklin loam, 0 to 3 percent slopes	63	IVs-3	102
RgB	Rocklin loam, 3 to 8 percent slopes	63	IVe-3	101
RgC	Rocklin loam, 8 to 15 percent slopes	64	IVe-3	101
RkA	Rocklin sandy loam, 0 to 3 percent slopes	64	IVs-3	102
RkB	Rocklin sandy loam, 3 to 8 percent slopes	64	IVe-3	101
RkB2	Rocklin sandy loam, 3 to 8 percent slopes, eroded	64	IVe-3	101

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS—Continued

Map symbol	Mapping unit	Page	Capability unit	Page
RkC2	Rocklin sandy loam, 8 to 15 percent slopes, eroded	64	VIe-9	104
RmA	Rossi clay, moderately saline-alkali, 0 to 1 percent slopes	64	VIw-6	105
RnA	Rossi clay, strongly saline-alkali, 0 to 1 percent slopes	65	VIw-6	105
RoA	Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes	65	IIIw-6	100
RpA	Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes	65	IVw-6	102
RrA	Rossi clay loam, strongly saline-alkali, 0 to 1 percent slopes	65	VIw-6	105
RsA	Ryer clay loam, 0 to 3 percent slopes	65	IIs-7	98
RsB	Ryer clay loam, 3 to 8 percent slopes	65	IIs-7	98
RtA	Ryer silt loam, 0 to 3 percent slopes	65	IIs-7	98
Sa	Sandstone rock land	63	VIIIs-1	106
SbA	San Joaquin loam, 0 to 3 percent slopes	66	IVs-3	102
SbB	San Joaquin loam, 3 to 8 percent slopes	66	IVe-3	101
ScA	San Joaquin sandy loam, 0 to 3 percent slopes	66	IVs-3	102
ScB	San Joaquin sandy loam, 3 to 8 percent slopes	66	IVe-3	101
SdA	San Joaquin-Alamo complex, 0 to 3 percent slopes	66	IVs-3	102
Se	Schist rock land	63	VIIIs-1	106
SfB	Sesame rocky loam, 3 to 8 percent slopes	67	VIe-4	103
SfD	Sesame rocky loam, 8 to 30 percent slopes	67	VIe-4	103
SgA	Seville clay, 0 to 3 percent slopes	67	IIIs-5	100
SgB	Seville clay, 3 to 8 percent slopes	67	IIIs-5	100
Sh	Slate rock land	63	VIIIs-1	106
Sk	Slickens	67	I-1	95
SmA	Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes	68	IIIw-2	99
SnA	Snelling sandy loam, 0 to 3 percent slopes	68	IIs-7	98
SnB	Snelling sandy loam, 3 to 8 percent slopes	68	IIs-7	98
SnB2	Snelling sandy loam, 3 to 8 percent slopes, eroded	68	IIIe-1	98
SnC	Snelling sandy loam, 8 to 15 percent slopes	68	IVe-1	101
SnC2	Snelling sandy loam, 8 to 15 percent slopes, eroded	68	IVe-1	101
SnD2	Snelling sandy loam, 15 to 30 percent slopes, eroded	68	VIe-4	103
Ta	Tailings	68	VIIIs-1	106
TbA	Temple clay loam, 0 to 1 percent slopes	69	IIw-2	96
TcA	Temple clay loam, slightly saline, 0 to 1 percent slopes	69	IIw-2	96
TdA	Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes	69	IIIw-2	99
TeA	Temple loam, 0 to 1 percent slopes	69	IIw-2	96
TfA	Temple loam, slightly saline, 0 to 1 percent slopes	69	IIw-2	96
Tg	Terrace escarpments	69	VIIIs-1	106
ThA	Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes	70	IIIs-6	100
TkA	Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes	70	IVs-6	103
TmA	Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes	70	IVs-6	103
TnA	Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	70	IIs-6	97
ToA	Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes	70	IIIs-6	100
TpA	Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	70	IVs-6	103
Tr	Tuff rock land	63	VIIIs-1	106
TsA	Tujunga gravelly sand, channeled, 0 to 8 percent slopes	71	IVe-4	101
TtA	Tujunga loamy sand, 0 to 3 percent slopes	71	IIIe-4	98
TuA	Tujunga sand, 0 to 3 percent slopes	71	IVe-4	101
TwA	Tujunga sand, channeled, 0 to 8 percent slopes	71	IVe-4	101
WaA	Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes	71	IVs-8	103
WbA	Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes.	72	IVs-8	103
WcA	Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes	72	VIs-8	105
WdA	Waukena loam, slightly saline-alkali, 0 to 1 percent slopes	72	IVs-8	103
WeA	Waukena loam, moderately saline-alkali, 0 to 1 percent slopes	72	IVs-8	103
WfA	Waukena loam, strongly saline-alkali, 0 to 1 percent slopes	72	VIs-8	105
WgB	Whiterock rocky silt loam, 3 to 8 percent slopes	72	VIIe-3	105
WgB2	Whiterock rocky silt loam, 3 to 8 percent slopes, eroded	72	VIIe-3	105
WgD	Whiterock rocky silt loam, 8 to 30 percent slopes	72	VIIe-3	105
WgD2	Whiterock rocky silt loam, 8 to 30 percent slopes, eroded	72	VIIe-3	105
WhB	Whitney fine sandy loam, 3 to 8 percent slopes	73	IIIe-1	98
WhB2	Whitney fine sandy loam, 3 to 8 percent slopes, eroded	73	IIIe-1	98
WhC	Whitney fine sandy loam, 8 to 15 percent slopes	73	IVe-1	101
WhC2	Whitney fine sandy loam, 8 to 15 percent slopes, eroded	73	IVe-1	101
WhD2	Whitney fine sandy loam, 15 to 30 percent slopes, eroded	73	VIe-4	103
WhE2	Whitney fine sandy loam, 30 to 45 percent slopes, eroded	73	VIIe-9	105
WkB	Whitney sandy loam, 3 to 8 percent slopes	73	IIIe-1	98
WkC	Whitney sandy loam, 8 to 15 percent slopes	73	IVe-1	101
WkC2	Whitney sandy loam, 8 to 15 percent slopes, eroded	73	IVe-1	101
WkD2	Whitney sandy loam, 15 to 30 percent slopes, eroded	73	VIe-4	103
WmB2	Whitney and Rocklin soils, 3 to 8 percent slopes, eroded	73	IIIe-1	98
WmC2	Whitney and Rocklin soils, 8 to 15 percent slopes, eroded	74	IVe-1	101
WnA	Wyman clay loam, deep over hardpan, 0 to 1 percent slopes	74	IIs-3	97
WoA	Wyman clay loam, 0 to 3 percent slopes	74	I-1	95
WpA	Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes.	74	IIs-3	97
WrA	Wyman loam, 0 to 3 percent slopes	74	I-1	95

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U.S. GOVERNMENT PRINTING OFFICE: 1991-281-364/20057

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For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

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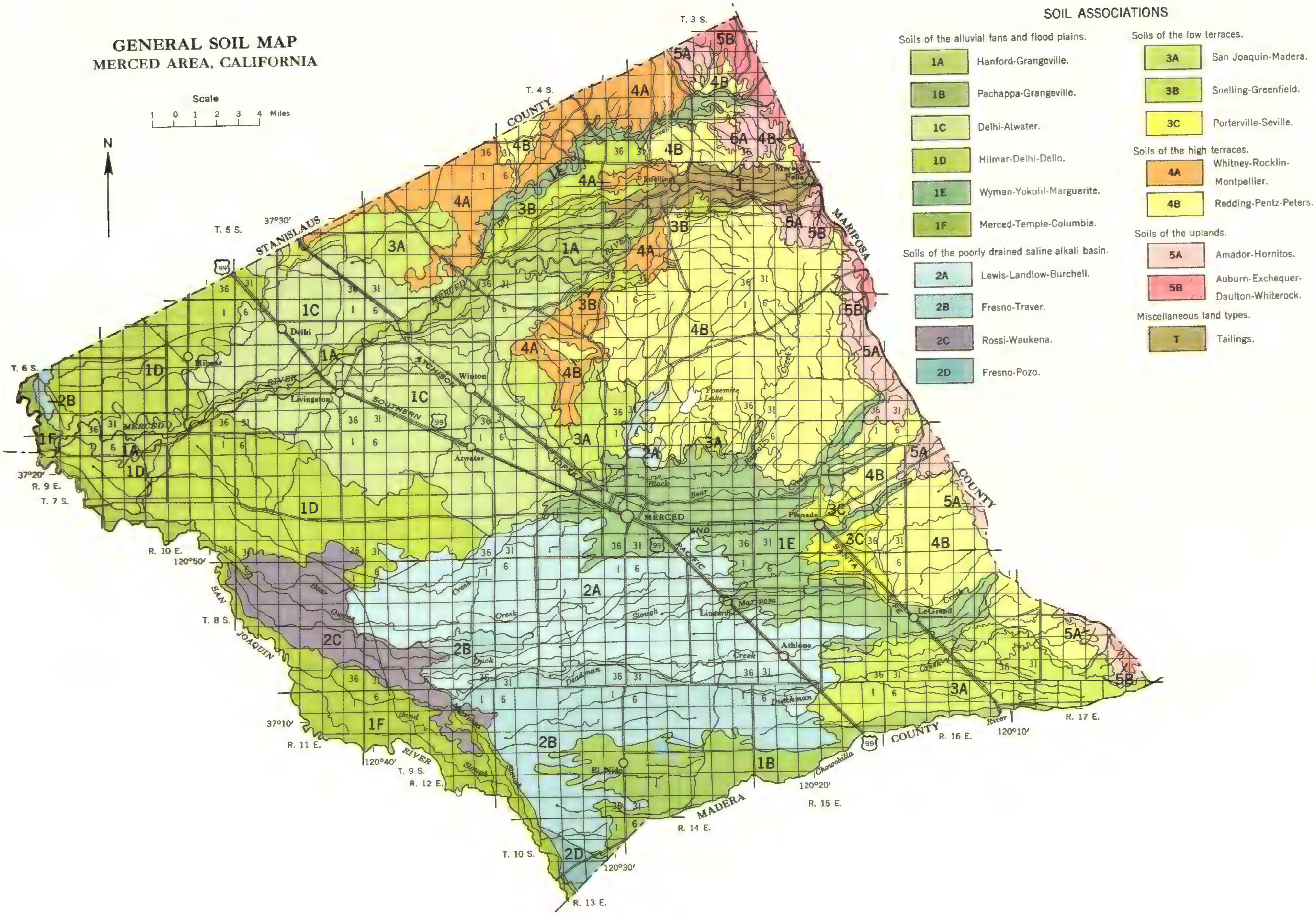
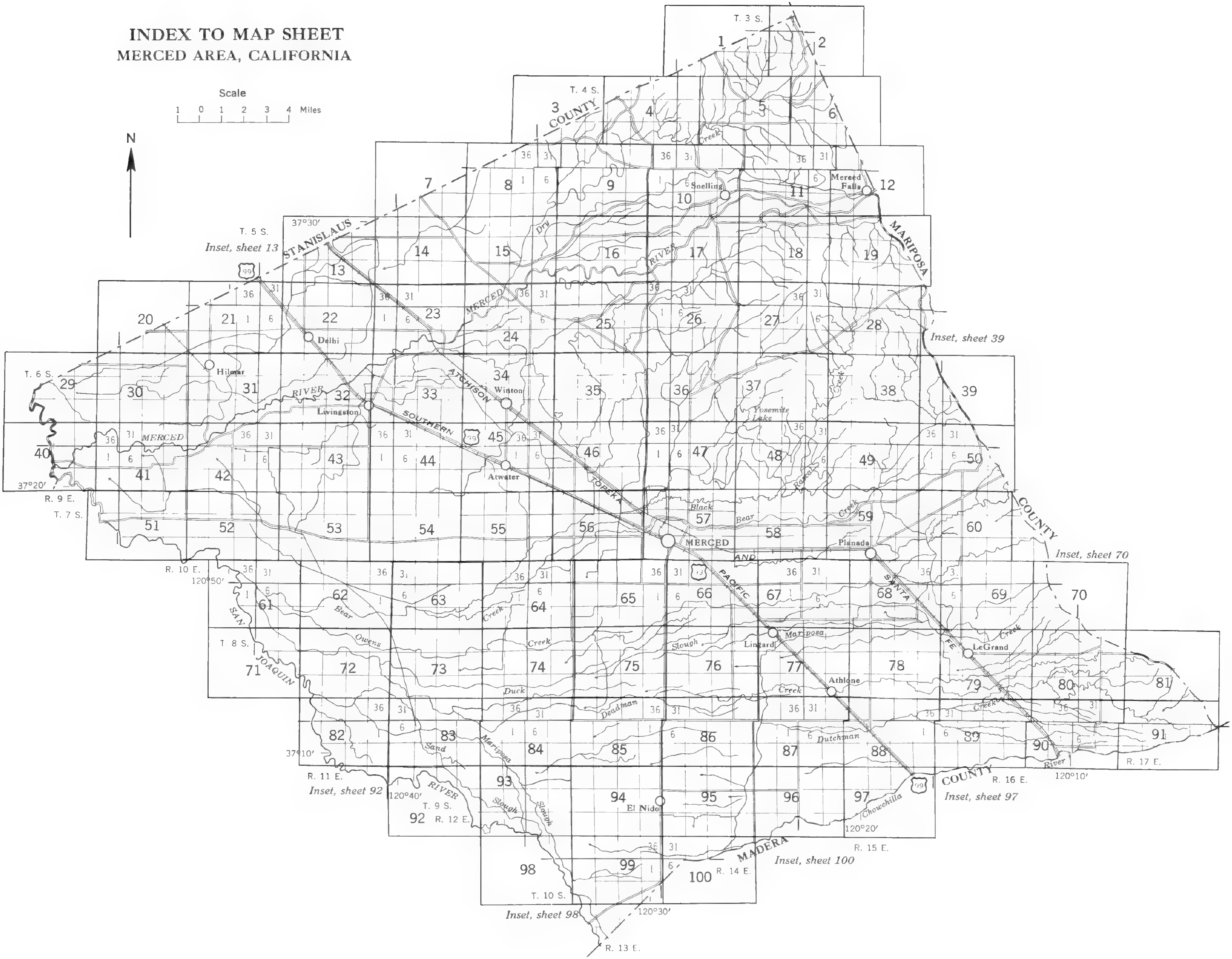

GENERAL SOIL MAP
MERCED AREA, CALIFORNIA
Scale
1 0 1 2 3 4 Miles
N
SOIL ASSOCIATIONS
Soils of the alluvial fans and flood plains.
1A Hanford-Grangeville.
1B Pachappa-Grangeville.
1C Delhi-Atwater.
1D Hilmar-Delhi-Dello.
1E Wyman-Yokohl-Marguerite.
1F Merced-Temple-Columbia.
Soils of the poorly drained saline-alkali basin.
2A Lewis-Landlow-Burchell.
2B Fresno-Traver.
2C Rossi-Waukena.
2D Fresno-Pozo.
Soils of the low terraces.
3A San Joaquin-Madera.
3B Snelling-Greenfield.
3C Porterville-Seville.
Soils of the high terraces.
4A Whitney-Rocklin-Montpellier.
4B Redding-Pentz-Peters.
Soils of the uplands.
5A Amador-Hornitos.
5B Auburn-Exchequer-Daulton-Whiterock.
Miscellaneous land types.
T Tailings.
STANISLAUS COUNTY
MARIPOSA COUNTY
MADERA COUNTY
SAN JOAQUIN RIVER
MERCED RIVER
Merced
Atwater
Livingston
Delhi
Hilmar
Winton
Snelling
Merced Falls
Planada
Le Grand
Athlone
Lingard
El Nido
Yosemite Lake
T. 3 S.
T. 4 S.
T. 5 S.
T. 6 S.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
R. 9 E.
R. 10 E.
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
R. 16 E.
R. 17 E.
37°30′
37°20′
37°10′
120°50′
120°40′
120°30′
120°20′
120°10′

INDEX TO MAP SHEET
MERCED AREA, CALIFORNIA



SOIL LEGEND

Each symbol consists of letters or a combination of letters and numbers. The first capital letter in the symbol, whether it is preceded by a number or not, is the initial of the soil series name. The second capital letter, if there is one, shows the class of slope. A capital letter is used to indicate slope only if slope forms part of the soil name. A number on the right-hand side of the symbol shows that the soil is eroded.

SYMBOL	NAME
AaA	Alamo clay, 0 to 1 percent slopes
AbB	Amador loam, 0 to 8 percent slopes
AbD	Amador loam, 8 to 30 percent slopes
AbE	Amador loam, 30 to 45 percent slopes
AcA	Anderson gravelly soils, channeled, 0 to 3 percent slopes
AdA	Atwater loamy sand, deep over hardpan, poorly drained variant, 0 to 1 percent slopes
AfA	Atwater loamy sand, 0 to 3 percent slopes
AfB	Atwater loamy sand, 3 to 8 percent slopes
AgA	Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes
AgB	Atwater loamy sand, deep over hardpan, 3 to 8 percent slopes
AkA	Atwater loamy sand, imperfectly drained variant, 0 to 3 percent slopes
AnA	Atwater sand, 0 to 3 percent slopes
AnB	Atwater sand, 3 to 8 percent slopes
ArB	Auburn rocky silt loam, 3 to 8 percent slopes
BaA	Bear Creek clay loam, 0 to 3 percent slopes
BcA	Bear Creek loam, 0 to 3 percent slopes
BdA	Bear Creek soils, 0 to 3 percent slopes
BeA	Borden fine sandy loam, 0 to 3 percent slopes
BfA	Borden fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes
BgA	Burchell silt loam, 0 to 1 percent slopes
BkA	Burchell silt loam, slightly saline-alkali, 0 to 1 percent slopes
BmA	Burchell silt loam, moderately saline-alkali, 0 to 1 percent slopes
BnA	Burchell silty clay loam, 0 to 1 percent slopes
BpA	Burchell silty clay loam, slightly saline-alkali, 0 to 1 percent slopes
BrA	Burchell silty clay loam, moderately saline-alkali, 0 to 1 percent slopes
CaA	Columbia fine sandy loam, moderately deep and deep, 0 to 1 percent slopes
CbA	Columbia loam, deep over hardpan, slightly saline, 0 to 1 percent slopes
CcA	Columbia silt loam, moderately deep and deep, 0 to 1 percent slopes
CeA	Columbia soils, channeled, 0 to 3 percent slopes
CfB	Corning cobbly loam, 3 to 8 percent slopes
CfD	Corning cobbly loam, 8 to 30 percent slopes
CgB	Corning gravelly loam, 0 to 8 percent slopes
CgD	Corning gravelly loam, 8 to 30 percent slopes
CgD2	Corning gravelly loam, 8 to 30 percent slopes, eroded
CgE2	Corning gravelly loam, 30 to 45 percent slopes, eroded
CkB	Corning gravelly sandy loam, 0 to 8 percent slopes
CkD	Corning gravelly sandy loam, 8 to 30 percent slopes
CkD2	Corning gravelly sandy loam, 8 to 30 percent slopes, eroded
CkE2	Corning gravelly sandy loam, 30 to 45 percent slopes, eroded
DaB	Daulton rocky silt loam, 3 to 8 percent slopes
DaD2	Daulton rocky silt loam, 8 to 30 percent slopes, eroded
DbA	Delhi loamy fine sand, 0 to 3 percent slopes
DbB	Delhi loamy fine sand, 3 to 8 percent slopes
DcA	Delhi loamy fine sand, silty substratum, 0 to 3 percent slopes
DdA	Delhi loamy sand, 0 to 3 percent slopes
DdB	Delhi loamy sand, 3 to 8 percent slopes
DeA	Delhi loamy sand, silty substratum, 0 to 3 percent slopes
DfA	Delhi sand, 0 to 3 percent slopes
DfB	Delhi sand, 3 to 8 percent slopes
DfC	Delhi sand, 8 to 15 percent slopes
DgA	Delhi sand, silty substratum, 0 to 3 percent slopes
DgB	Delhi sand, silty substratum, 3 to 8 percent slopes
DhA	Dello loamy fine sand, 0 to 1 percent slopes
DkA	Dello sand, 0 to 1 percent slopes
DmA	Dello sand, poorly drained, 0 to 1 percent slopes
DnA	Dello sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes
DoA	Dello sand, slightly saline-alkali, 0 to 1 percent slopes
DpA	Dinuba sandy loam, 0 to 1 percent slopes
DrA	Dinuba sandy loam, slightly saline-alkali, 0 to 1 percent slopes
DsA	Dinuba sandy loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes
DtA	Dinuba sandy loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes
DuA	Dune land, 0 to 3 percent slopes
DuB	Dune land, 3 to 8 percent slopes
EaD	Exchequer and Auburn rocky silt loams, 8 to 30 percent slopes
FaA	Foster fine sandy loam, 0 to 1 percent slopes
FbA	Foster fine sandy loam, very poorly drained, 0 to 1 percent slopes
FcA	Foster fine sandy loam, very poorly drained, slightly saline-alkali, 0 to 1 percent slopes
FdA	Foster fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes
FeA	Foster gravelly fine sandy loam, 0 to 1 percent slopes
FfA	Fresno clay loam, slightly saline-alkali, 0 to 1 percent slopes
FgA	Fresno clay loam, moderately saline-alkali, 0 to 1 percent slopes
FkA	Fresno clay loam, strongly saline-alkali, 0 to 1 percent slopes
FmA	Fresno loam, poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes
FnA	Fresno loam, poorly drained variant, moderately saline-alkali, 0 to 1 percent slopes
FoA	Fresno loam, poorly drained variant, strongly saline alkali, 0 to 1 percent slopes
FpA	Fresno loam, slightly saline-alkali, 0 to 1 percent slopes
FrA	Fresno loam, moderately saline-alkali, 0 to 1 percent slopes
FsA	Fresno loam, strongly saline-alkali, 0 to 1 percent slopes
GaA	Grangeville fine sandy loam, 0 to 1 percent slopes
GbA	Grangeville loam, 0 to 1 percent slopes
GcA	Grangeville loam, slightly saline-alkali, 0 to 1 percent slopes
GdA	Grangeville loam, moderately saline-alkali, 0 to 1 percent slopes
GeA	Greenfield sandy loam, deep over hardpan, poorly drained variant, 0 to 1 percent slopes
GfA	Greenfield sandy loam, deep over hardpan, 0 to 3 percent slopes
GfB	Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes
GfB3	Greenfield sandy loam, deep over hardpan, 3 to 8 percent slopes, gullied
HaA	Hanford fine sandy loam, 0 to 1 percent slopes
HbA	Hanford fine sandy loam, moderately deep and deep over sand, 0 to 1 percent slopes
HcB	Hanford fine sandy loam, channeled, 0 to 8 percent slopes
HdA	Hanford gravelly sandy loam, 0 to 1 percent slopes
HeA	Hanford sandy loam, 0 to 1 percent slopes
HfA	Hilmar loamy sand, poorly drained, slightly saline-alkali, 0 to 1 percent slopes
HgA	Hilmar loamy sand, 0 to 3 percent slopes
HhA	Hilmar loamy sand, slightly saline-alkali, 0 to 3 percent slopes
HkA	Hilmar sand, poorly drained, 0 to 1 percent slopes
HmA	Hilmar sand, poorly drained, moderately saline-alkali, 0 to 1 percent slopes
HnA	Hilmar sand, poorly drained, strongly saline-alkali, 0 to 1 percent slopes
HoA	Hilmar sand, 0 to 3 percent slopes
HpA	Hilmar sand, slightly saline-alkali, 0 to 3 percent slopes
HrA	Honcut fine sandy loam, 0 to 1 percent slopes
HsA	Honcut gravelly sandy loam, 0 to 1 percent slopes
HtA	Honcut silt loam, 0 to 1 percent slopes
HuA	Honcut silt loam, deep over hardpan, 0 to 1 percent slopes
HwA	Honcut silty clay loam, 0 to 1 percent slopes
HxA	Honcut silty clay loam, deep over hardpan, 0 to 1 percent slopes
HzA	Honcut silty clay loam, channeled, 0 to 8 percent slopes
2HB	Hopeton clay, 0 to 8 percent slopes
3HA	Hopeton clay loam, 0 to 3 percent slopes
3HB	Hopeton clay loam, 3 to 8 percent slopes
3HC	Hopeton clay loam, 8 to 15 percent slopes
4HB	Hopeton gravelly clay loam, 0-8 percent slopes
5HB	Hornitos fine sandy loam, 3 to 8 percent slopes
5HD	Hornitos fine sandy loam, 8 to 30 percent slopes
5HE	Hornitos fine sandy loam, 30 to 45 percent slopes
6HB	Hornitos gravelly fine sandy loam, 0 to 8 percent slopes
6HD	Hornitos gravelly fine sandy loam, 8 to 30 percent slopes
KaB	Keyes gravelly clay loam, 0 to 8 percent slopes
KbB	Keyes gravelly loam, 0 to 8 percent slopes
KbC	Keyes gravelly loam, 8 to 15 percent slopes
KcB	Keyes-Pentz gravelly loams, 0 to 8 percent slopes
LaA	Landlow clay, 0 to 1 percent slopes
LbA	Landlow clay, slightly saline-alkali, 0 to 1 percent slopes
LcA	Landlow silt loam, 0 to 1 percent slopes
LdA	Landlow silt loam, slightly saline-alkali, 0 to 1 percent slopes
LeA	Landlow silty clay loam, 0 to 1 percent slopes
LfA	Landlow silty clay loam, slightly saline-alkali, 0 to 1 percent slopes
LgA	Lewis clay, slightly saline-alkali, 0 to 1 percent slopes
LhA	Lewis clay, moderately saline-alkali, 0 to 1 percent slopes
LkA	Lewis loam, slightly saline-alkali, 0 to 1 percent slopes
LmA	Lewis loam, moderately saline-alkali, 0 to 1 percent slopes
LnA	Lewis loam, strongly saline-alkali, 0 to 1 percent slopes
LoA	Lewis silty clay loam, slightly saline-alkali, 0 to 1 percent slopes
LpA	Lewis silty clay loam, moderately saline-alkali, 0 to 1 percent slopes
LrA	Lewis silty clay loam, strongly saline-alkali, 0 to 1 percent slopes
MaA	Madera fine sandy loam, 0 to 3 percent slopes
MbA	Madera loam, 0 to 1 percent slopes
McA	Madera loam, slightly saline-alkali, 0 to 1 percent slopes
MdA	Madera sandy loam, 0 to 3 percent slopes
MdB	Madera sandy loam, 3 to 8 percent slopes
MeA	Marguerite loam, 0 to 1 percent slopes
MfA	Marguerite silty clay loam, 0 to 1 percent slopes
MgA	Marguerite silty clay loam, deep over hardpan, 0 to 1 percent slopes
MhA	Merced clay, slightly saline, 0 to 1 percent slopes
MkA	Merced clay, moderately saline, 0 to 1 percent slopes
MmA	Merced clay loam, slightly saline, 0 to 1 percent slopes
MnA	Merced clay loam, moderately saline, 0 to 1 percent slopes
MoA	Merced clay loam, strongly saline, channeled, 0 to 3 percent slopes
MpA	Merced silt loam, overwashed, slightly saline, 0 to 1 percent slopes
MrA	Montpellier coarse sandy loam, 0 to 3 percent slopes
MrB	Montpellier coarse sandy loam, 3 to 8 percent slopes
MrC	Montpellier coarse sandy loam, 8 to 15 percent slopes
MrC2	Montpellier coarse sandy loam, 8 to 15 percent slopes, eroded
MrD2	Montpellier coarse sandy loam, 15 to 30 percent slopes, eroded
MrE2	Montpellier coarse sandy loam, 30 to 45 percent slopes, eroded
PaA	Pachappa fine sandy loam, 0 to 1 percent slopes
PbA	Pachappa fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes
PcA	Pachappa fine sandy loam, deep over hardpan, 0 to 1 percent slopes
PdA	Pachappa sandy loam, 0 to 1 percent slopes
PeA	Pachappa sandy loam, slightly saline-alkali, 0 to 1 percent slopes
PfA	Pachappa sandy loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes
PgA	Pachappa sandy loam, deep over hardpan, 0 to 1 percent slopes
PhB	Pentz clay loam, 0 to 8 percent slopes
PhD	Pentz clay loam, 8 to 30 percent slopes
PkB	Pentz gravelly loam, 0 to 8 percent slopes
PkD	Pentz gravelly loam, 8 to 30 percent slopes
PmB	Pentz loam, 0 to 8 percent slopes
PmD	Pentz loam, 8 to 30 percent slopes
PmE	Pentz loam, 30 to 75 percent slopes
PnB	Peters clay, 0 to 8 percent slopes
PnC	Peters clay, 8 to 15 percent slopes
PoB	Peters cobbly clay, 0 to 8 percent slopes
PoD	Peters cobbly clay, 8 to 30 percent slopes
PpA	Piper fine sandy loam, slightly saline-alkali, 0 to 3 percent slopes
PsA	Piper fine sandy loam, moderately saline-alkali, 0 to 3 percent slopes
PtA	Piper fine sandy loam, strongly saline-alkali, 0 to 3 percent slopes
PuA	Piper soils, strongly saline-alkali, channeled, 0 to 3 percent slopes
Pv	Pits
PwA	Porterville clay, 0 to 3 percent slopes
PwB	Porterville clay, 3 to 8 percent slopes
PxA	Pozo clay loam, 0 to 1 percent slopes
PyA	Pozo clay loam, slightly saline, 0 to 1 percent slopes
PzA	Pozo clay loam, moderately saline, 0 to 1 percent slopes
RaA	Raynor clay, 0 to 3 percent slopes
RaB	Raynor clay, 3 to 8 percent slopes
RaC	Raynor clay, 8 to 15 percent slopes
RbA	Raynor cobbly clay, 0 to 3 percent slopes
RbB	Raynor cobbly clay, 3 to 8 percent slopes
RbC	Raynor cobbly clay, 8 to 15 percent slopes
RcB	Redding cobbly loam, 0 to 8 percent slopes
RdA	Redding gravelly loam, poorly drained variant, 0 to 3 percent slopes
ReB	Redding gravelly loam, 0 to 8 percent slopes
ReD	Redding gravelly loam, 8 to 30 percent slopes
Rf	Riverwash
RgA	Rocklin loam, 0 to 3 percent slopes
RgB	Rocklin loam, 3 to 8 percent slopes
RgC	Rocklin loam, 8 to 15 percent slopes
RkA	Rocklin sandy loam, 0 to 3 percent slopes
RkB	Rocklin sandy loam, 3 to 8 percent slopes
RkB2	Rocklin sandy loam, 3 to 8 percent slopes, eroded
RkC2	Rocklin sandy loam, 8 to 15 percent slopes, eroded
RmA	Rossi clay, moderately saline-alkali, 0 to 1 percent slopes
RnA	Rossi clay, strongly saline-alkali, 0 to 1 percent slopes
RoA	Rossi clay loam, slightly saline-alkali, 0 to 1 percent slopes
RpA	Rossi clay loam, moderately saline-alkali, 0 to 1 percent slopes
RrA	Rossi clay loam, strongly saline alkali, 0 to 1 percent slopes
RsA	Ryer clay loam, 0 to 3 percent slopes
RsB	Ryer clay loam, 3 to 8 percent slopes
RtA	Ryer silt loam, 0 to 3 percent slopes
Sa	Sandstone rock land
SbA	San Joaquin loam, 0 to 3 percent slopes
SbB	San Joaquin loam, 3 to 8 percent slopes
ScA	San Joaquin sandy loam, 0 to 3 percent slopes
ScB	San Joaquin sandy loam, 3 to 8 percent slopes
SdA	San Joaquin-Alamo complex, 0 to 3 percent slopes
Se	Schist rock land
SfB	Sesame rocky loam, 3 to 8 percent slopes
SfD	Sesame rocky loam, 8 to 30 percent slopes
SgA	Seville clay, 0 to 3 percent slopes
SgB	Seville clay, 3 to 8 percent slopes
Sh	Slate rock land
Sk	Slickens
SmA	Snelling sandy loam, imperfectly drained variant, 0 to 1 percent slopes
SnA	Snelling sandy loam, 0 to 3 percent slopes
SnB	Snelling sandy loam, 3 to 8 percent slopes
SnB2	Snelling sandy loam, 3 to 8 percent slopes, eroded
SnC	Snelling sandy loam, 8 to 15 percent slopes
SnC2	Snelling sandy loam, 8 to 15 percent slopes, eroded
SnD2	Snelling sandy loam, 15 to 30 percent slopes, eroded
Ta	Tailings
TbA	Temple clay loam, 0 to 1 percent slopes
TcA	Temple clay loam, slightly saline, 0 to 1 percent slopes
TdA	Temple clay loam, slightly saline, channeled, 0 to 3 percent slopes
TeA	Temple loam, 0 to 1 percent slopes
TfA	Temple loam, slightly saline, 0 to 1 percent slopes
Tg	Terrace escarpments
ThA	Traver clay loam, slightly saline-alkali, 0 to 1 percent slopes
TkA	Traver clay loam, moderately saline-alkali, 0 to 1 percent slopes
TmA	Traver clay loam, strongly saline-alkali, 0 to 1 percent slopes
TnA	Traver fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes
ToA	Traver fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes
TpA	Traver fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes
Tr	Tuff rock land
TsA	Tujunga gravelly sand, channeled, 0 to 8 percent slopes
TtA	Tujunga loamy sand, 0 to 3 percent slopes
TuA	Tujunga sand, 0 to 3 percent slopes
TwA	Tujunga sand, channeled, 0 to 8 percent slopes
WaA	Waukena fine sandy loam, slightly saline-alkali, 0 to 1 percent slopes
WbA	Waukena fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes
WcA	Waukena fine sandy loam, strongly saline-alkali, 0 to 1 percent slopes
WdA	Waukena loam, slightly saline-alkali, 0 to 1 percent slopes
WeA	Waukena loam, moderately saline-alkali, 0 to 1 percent slopes
WfA	Waukena loam, strongly saline-alkali, 0 to 1 percent slopes
WgB	Whiterock rocky silt loam, 3 to 8 percent slopes
WgB2	Whiterock rocky silt loam, 3 to 8 percent slopes, eroded
WgD	Whiterock rocky silt loam, 8 to 30 percent slopes
WgD2	Whiterock rocky silt loam, 8 to 30 percent slopes, eroded
WhB	Whitney fine sandy loam, 3 to 8 percent slopes
WhB2	Whitney fine sandy loam, 3 to 8 percent slopes, eroded
WhC	Whitney fine sandy loam, 8 to 15 percent slopes
WhC2	Whitney fine sandy loam, 8 to 15 percent slopes, eroded
WhD2	Whitney fine sandy loam, 15 to 30 percent slopes, eroded
WhE2	Whitney fine sandy loam, 30 to 45 percent slopes, eroded
WkB	Whitney sandy loam, 3 to 8 percent slopes
WkC	Whitney sandy loam, 8 to 15 percent slopes
WkC2	Whitney sandy loam, 8 to 15 percent slopes, eroded
WkD2	Whitney sandy loam, 15 to 30 percent slopes, eroded
WmB2	Whitney and Rocklin soils, 3 to 8 percent slopes, eroded
WmC2	Whitney and Rocklin soils, 8 to 15 percent slopes, eroded
WnA	Wyman clay loam, deep over hardpan, 0 to 1 percent slopes
WoA	Wyman clay loam, 0 to 3 percent slopes
WpA	Wyman loam, deep over hardpan, slightly saline-alkali, 0 to 1 percent slopes
WrA	Wyman loam, 0 to 3 percent slopes
WsA	Wyman loam, deep over hardpan, 0 to 3 percent slopes
WtA	Wyman loam, moderately deep and deep over gravel, 0 to 3 percent slopes
YaA	Yokohl clay, 0 to 3 percent slopes
YbA	Yokohl clay loam, 0 to 3 percent slopes
YcA	Yokohl loam, 0 to 3 percent slopes
YcB	Yokohl loam, 3 to 8 percent slopes
YdA	Yolo loam, 0 to 1 percent slopes
YeA	Yolo loam, deep over hardpan, 0 to 1 percent slopes

Soils surveyed 1944-49 by Rodney J. Arkley, Ralph C. Cole, and Gordon L. Huntington, University of California Agricultural Experiment Station, and Alan B. Carlton, Ralph J. McCracken and George K. Smith, U. S. Department of Agriculture.
Correlation by Robert A. Gardner and Rudolph Ulrich, U. S. Department of Agriculture.

Soil map constructed 1960 by Cartographic Division, Soil Conservation Service, USDA, from 1950 aerial photographs. Controlled mosaic based on California plane coordinate system, third zone, 1927 North American datum.

MERCED AREA, CALIFORNIA
CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Roads
- Good motor
- Poor motor
- Trail
- Marker, U. S. (33)

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mine and Quarry

Dump

Pits, gravel or other

Power line

Pipeline

Cemetery

Dam

Levee

Tank

Forest fire or lookout station

Fort

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches (CANAL, DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells (flowing)

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

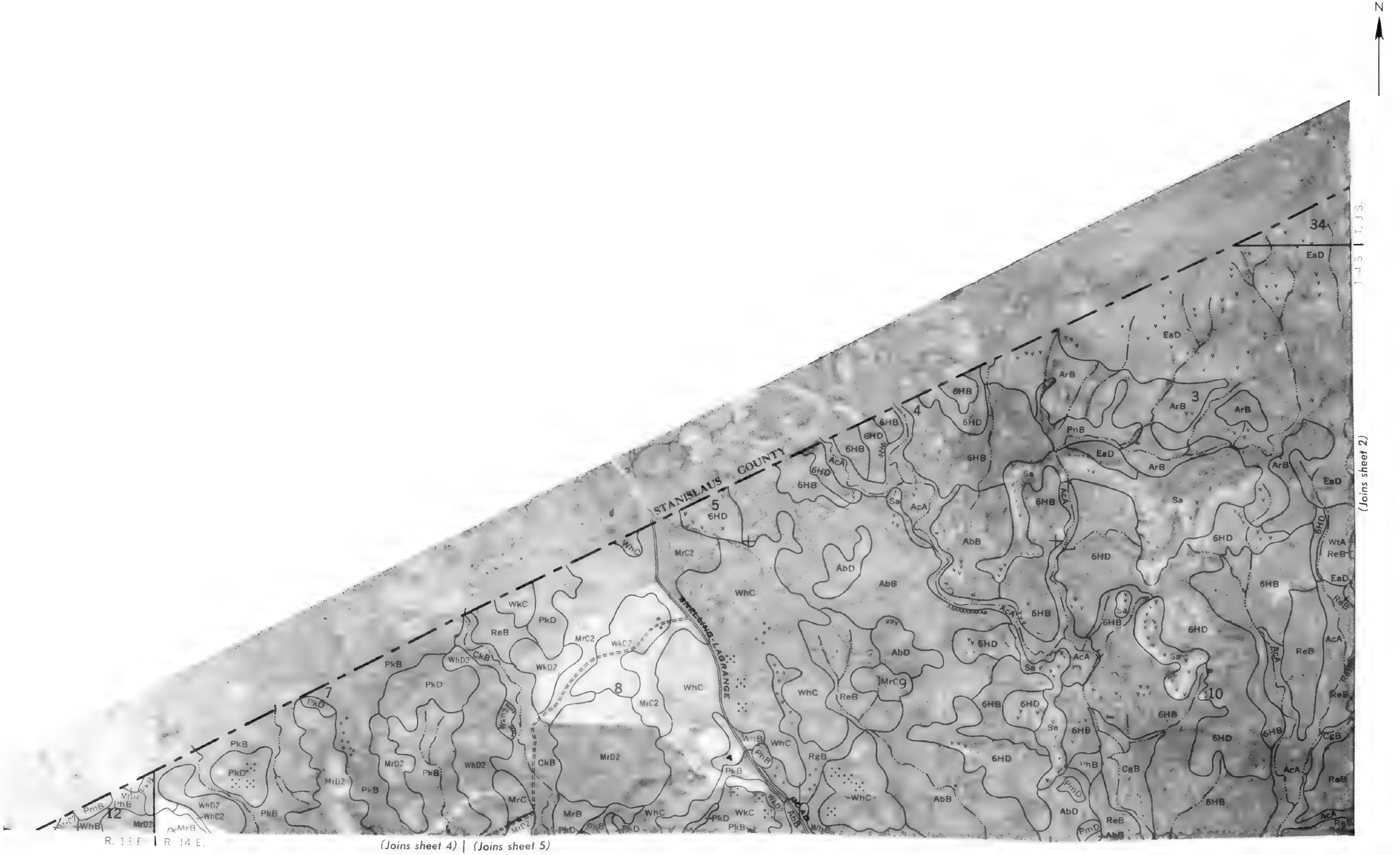
Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil type outline and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies
- Saline spot

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in [illegible].

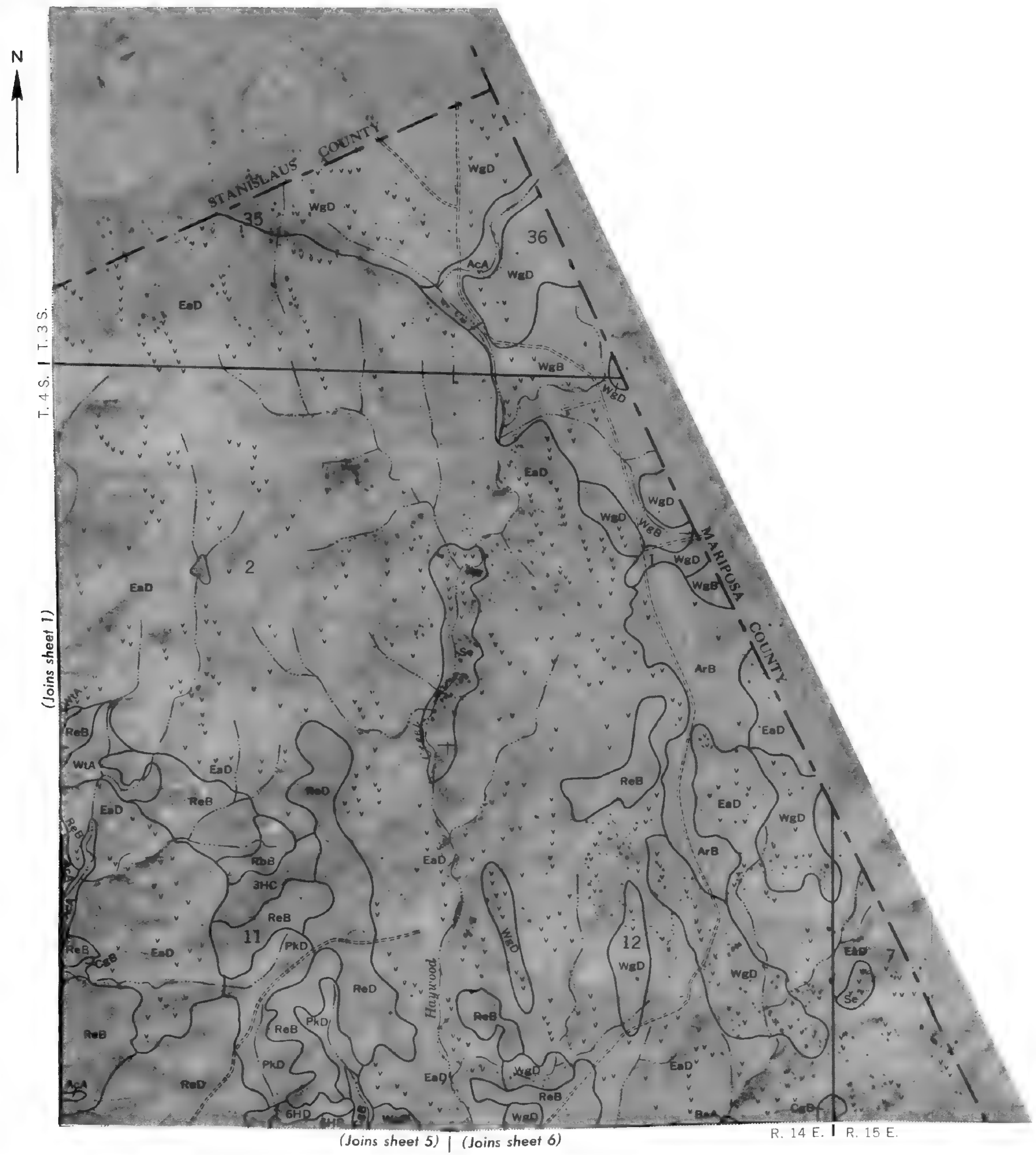
Range, township, and section corners shown on this map are indefinite.



(Joins sheet 4) | (Joins sheet 5)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

2



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

N

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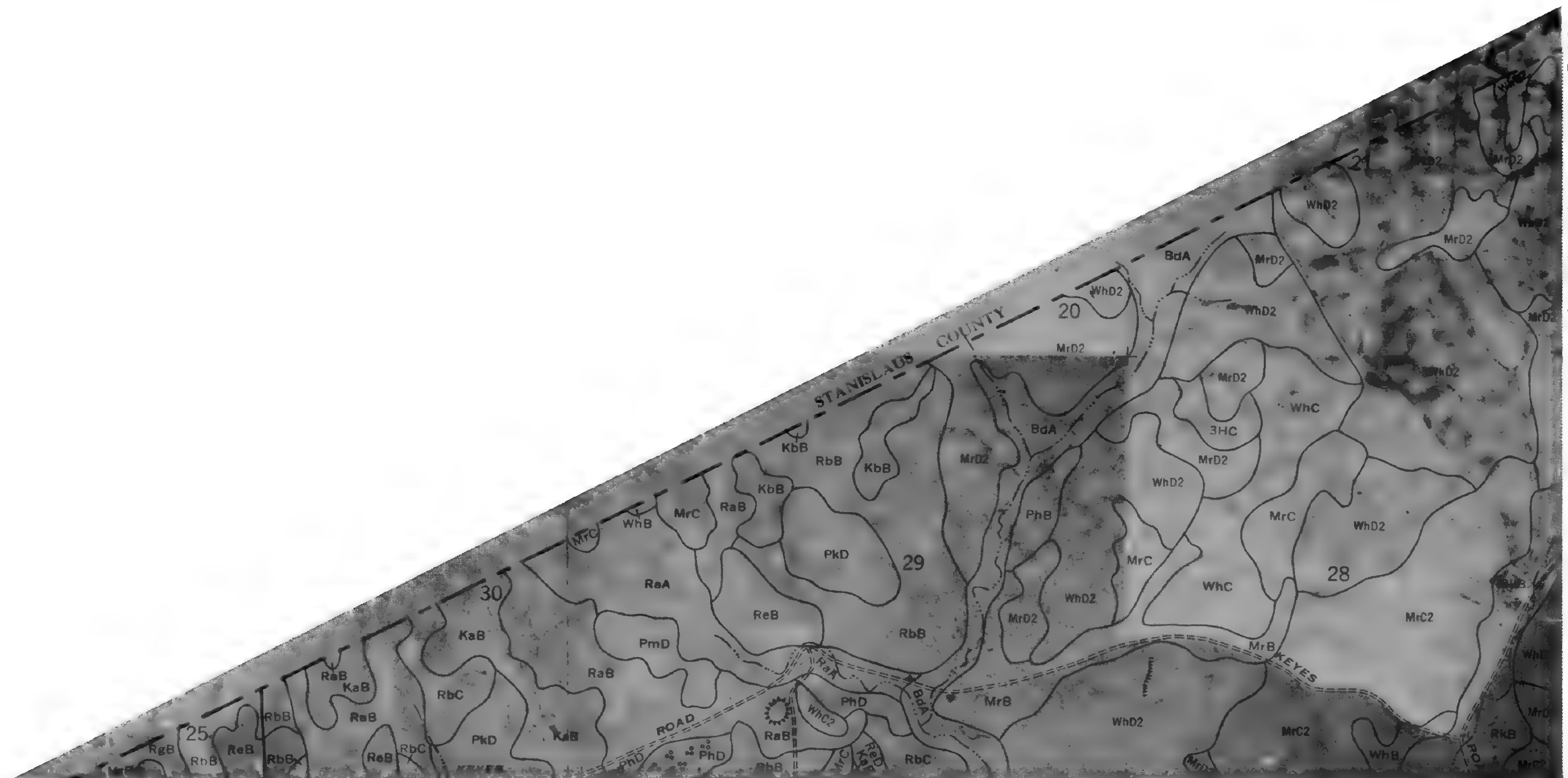
T. 4 S.

(Joins sheet 4)



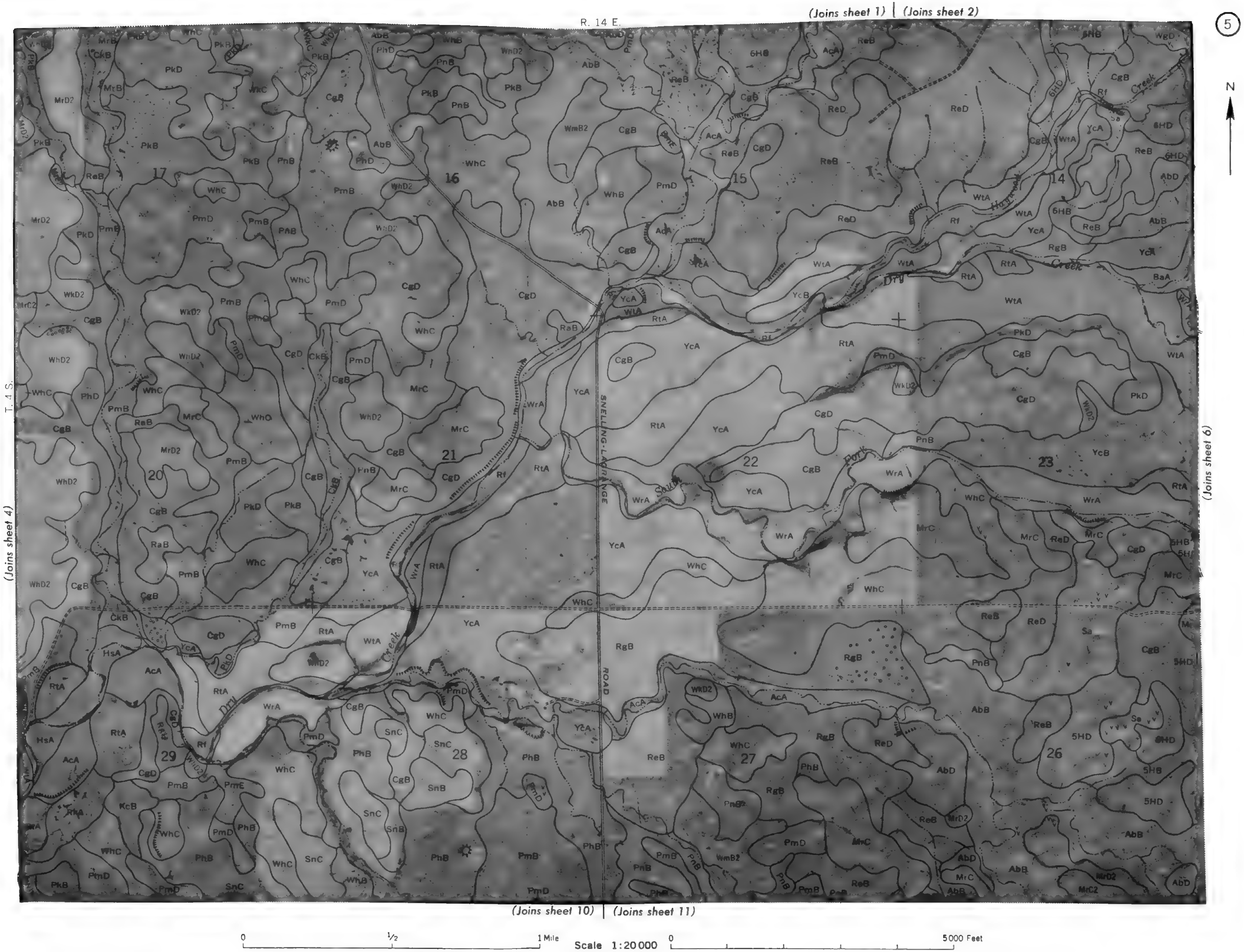
R. 12 E. | R. 13 E.

(Joins sheet 8) | (Joins sheet 9)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet


4
N
R. 13 E.
R. 14 E.
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 5)
T. 4 S.
(Joins sheet 9)
(Joins sheet 10)
STANISLAUS COUNTY
14
13
18
15
22
23
24
19
27
26
25
30
Creek
Dry
Creek
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 5



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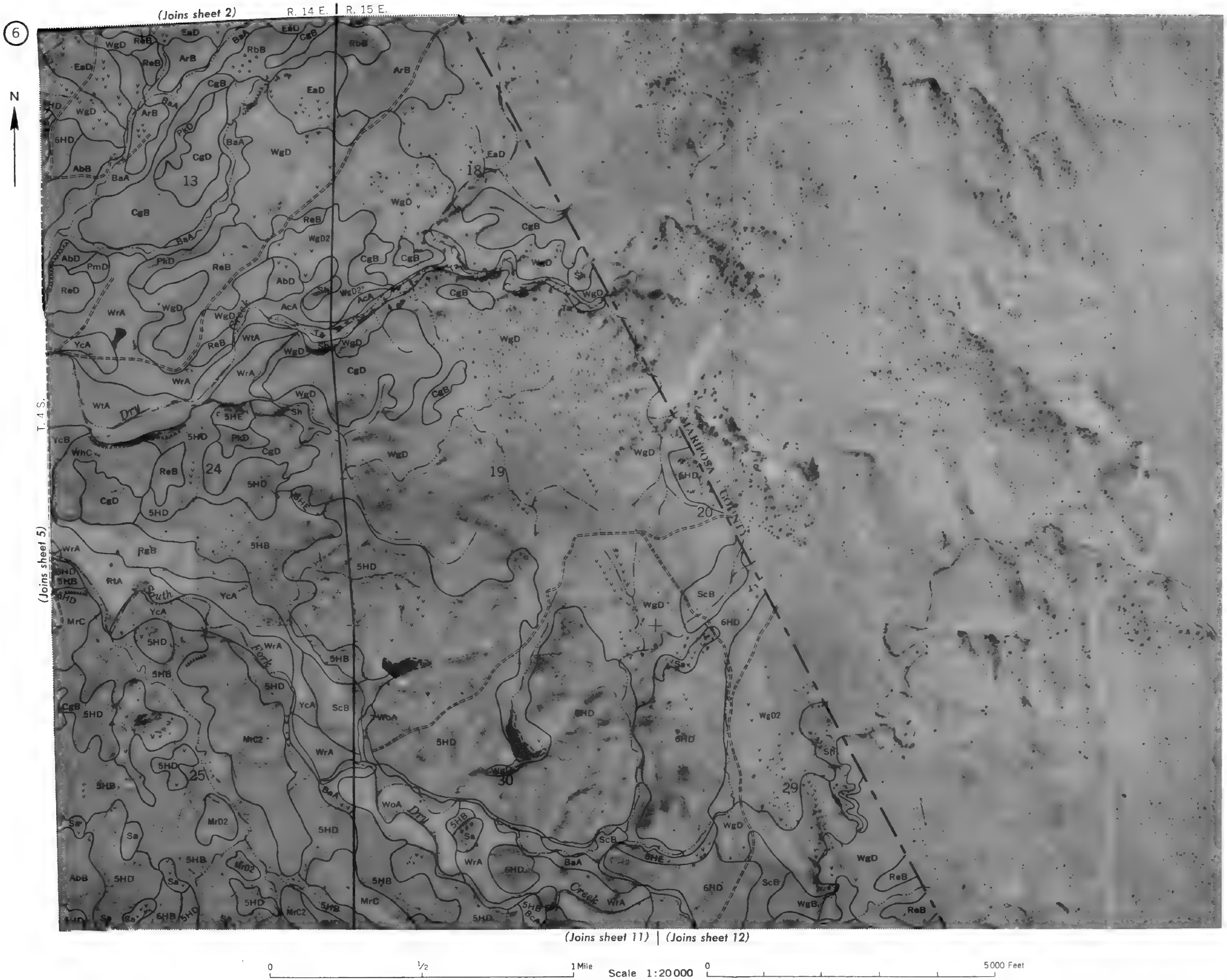
Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 6



7

N

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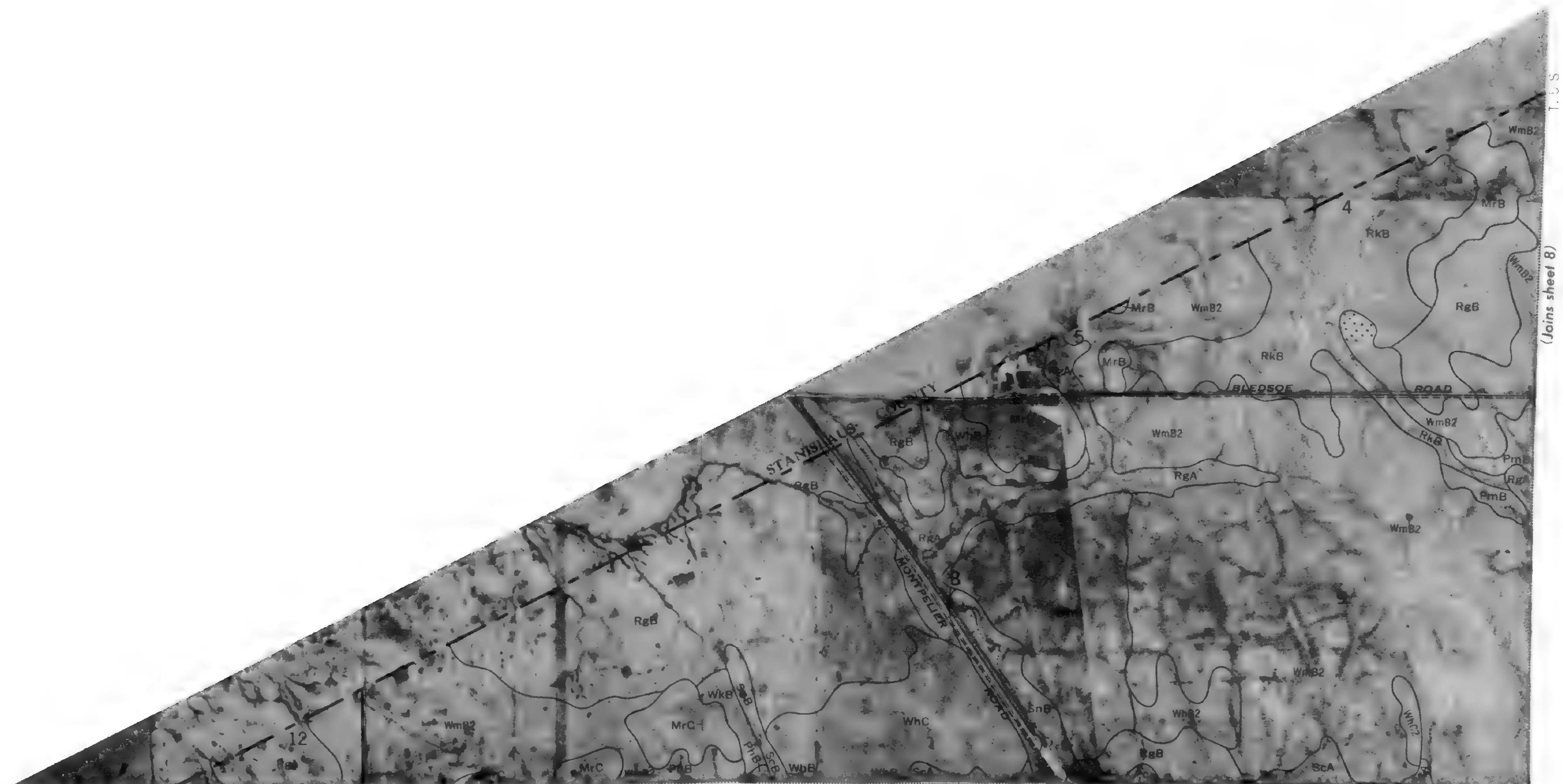
Range, township, and section corners shown on this map are indefinite.



(Joins sheet 8)

R. 11 E. | R. 12 E.

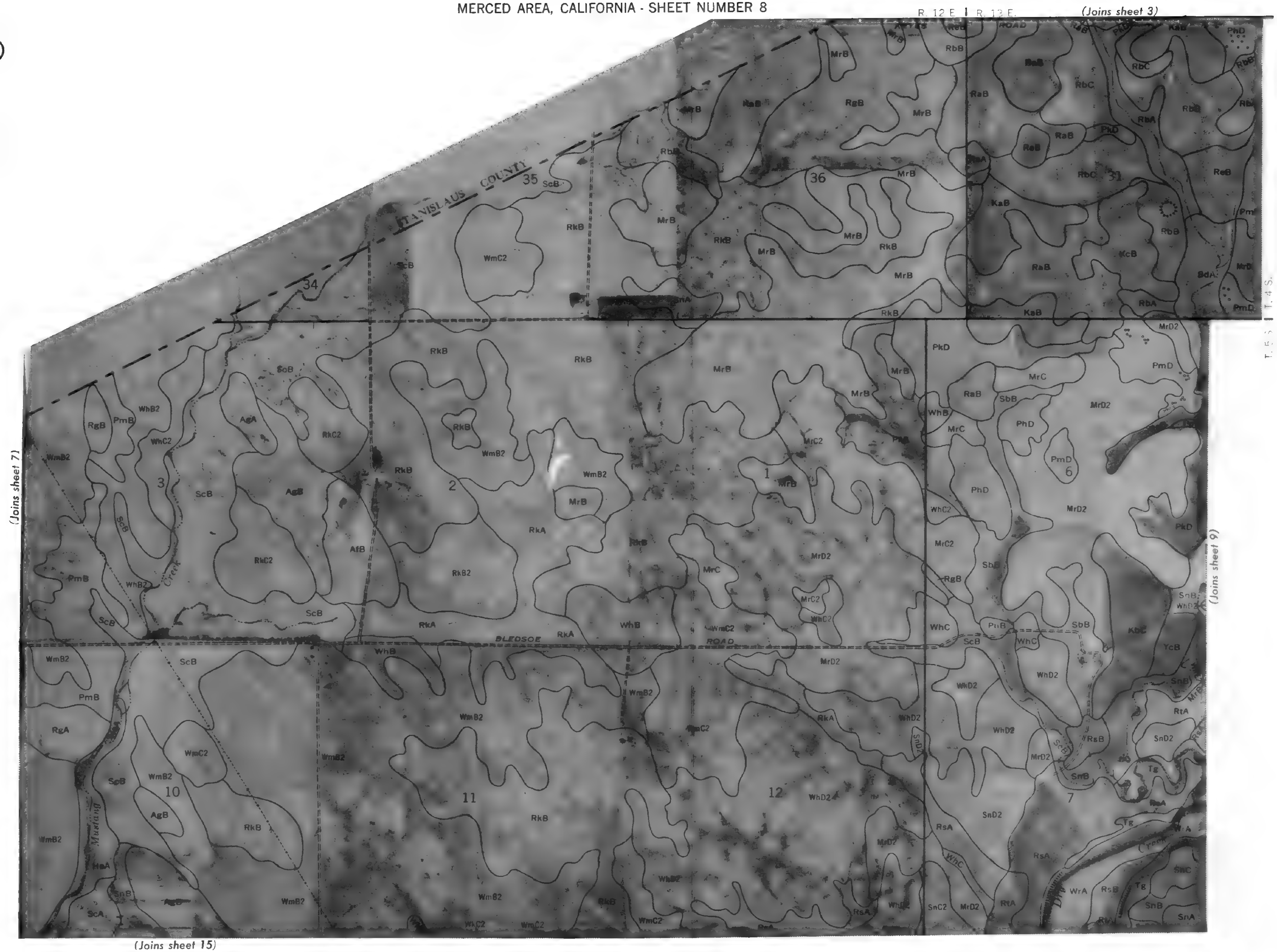
(Joins sheet 14)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 8

8

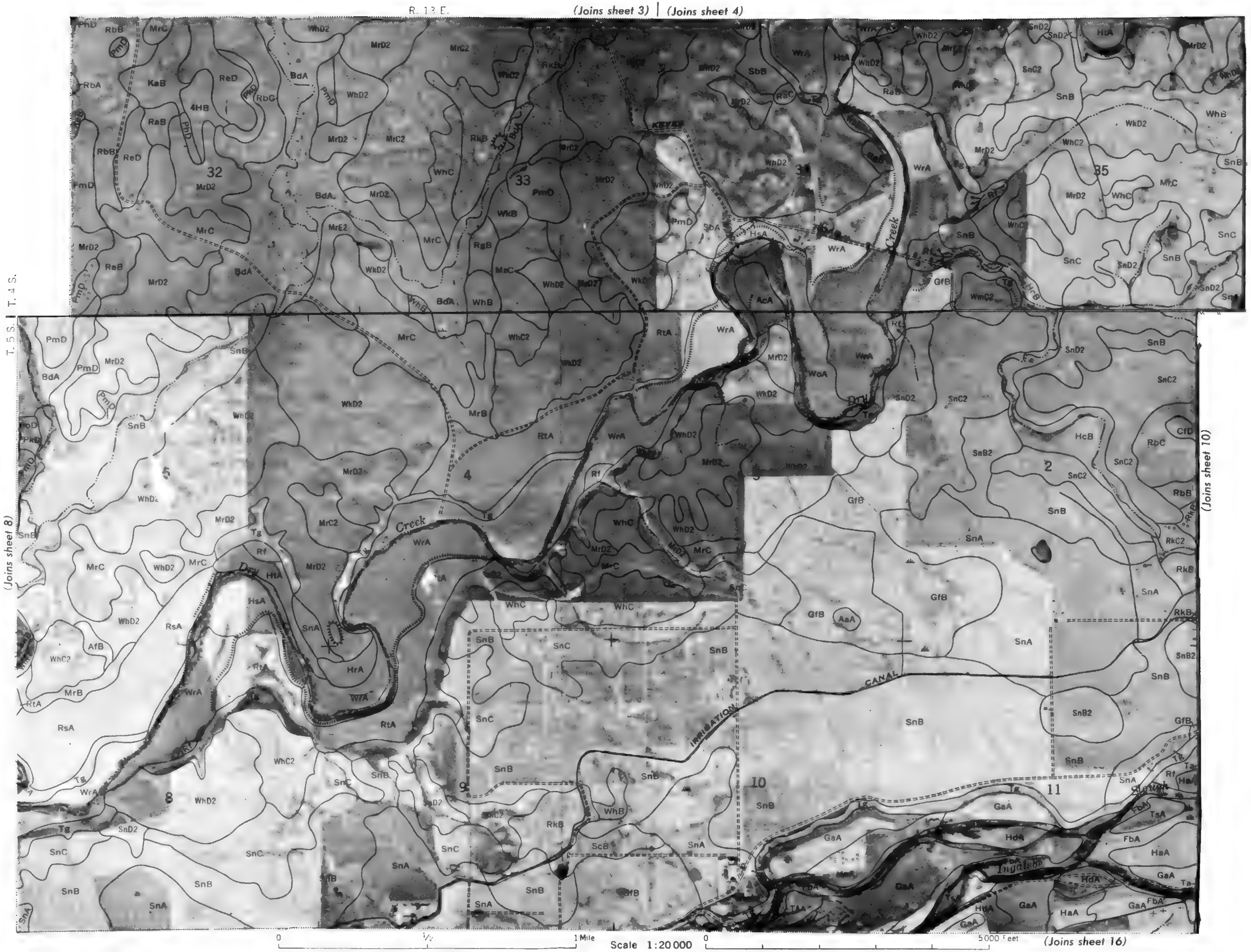
N



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet



Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 10

(10)

R. 13 E. | R. 14 E. (Joins sheet 4) | (Joins sheet 5)

N

(Joins sheet 17)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 5) | (Joins sheet 6)

R. 14 E. | R. 15 E.

11

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

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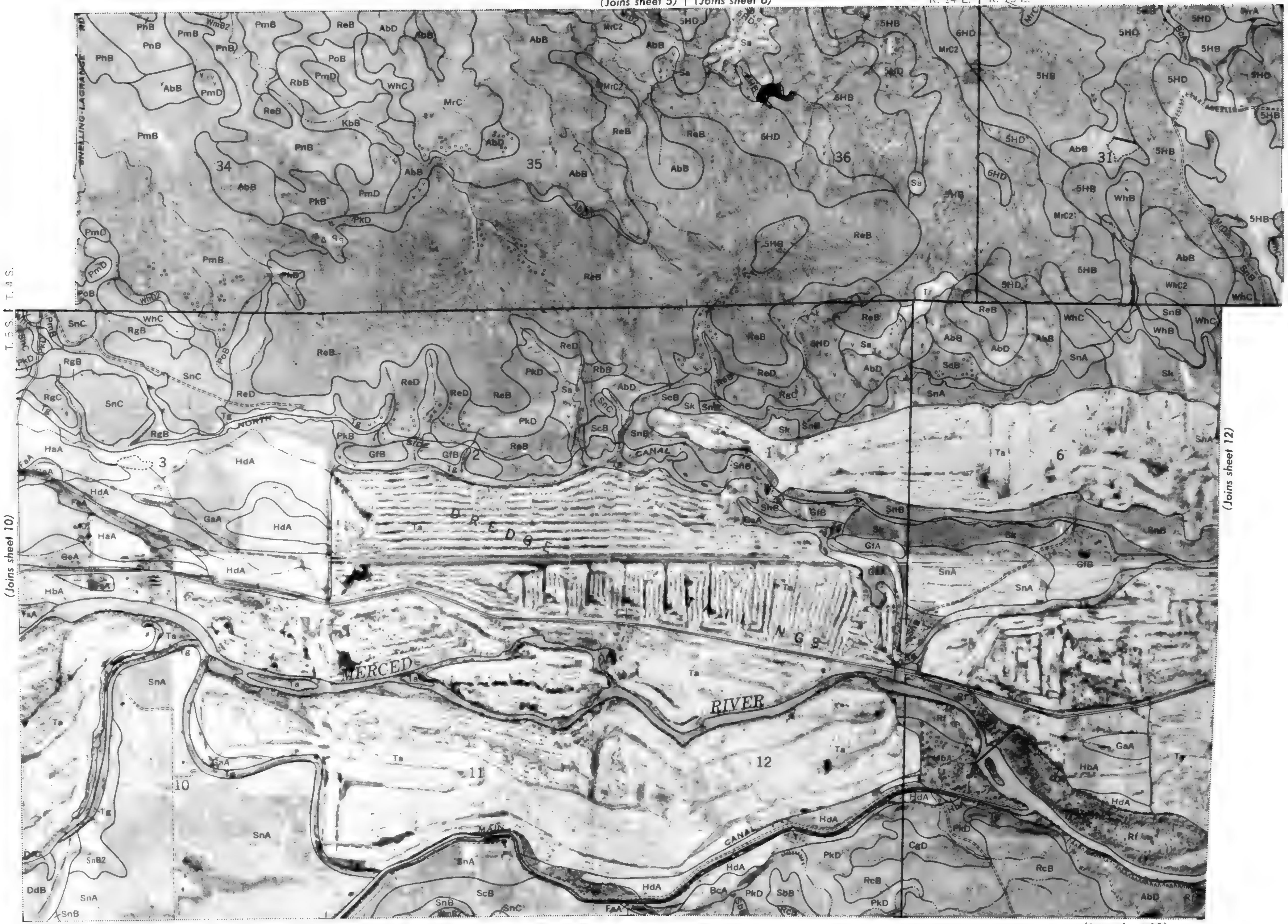

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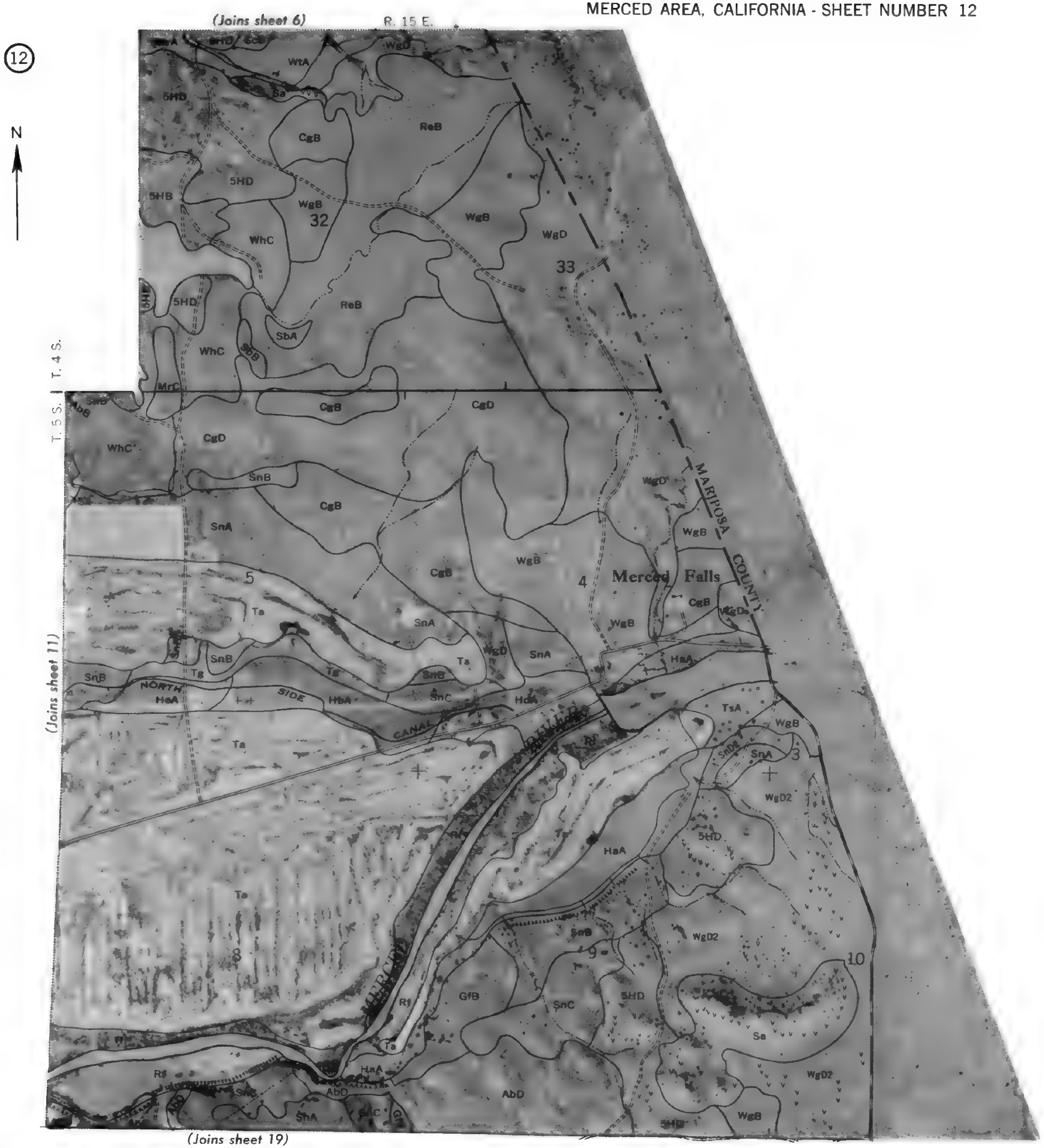
0 1/2 1 Mile Scale 1:20 000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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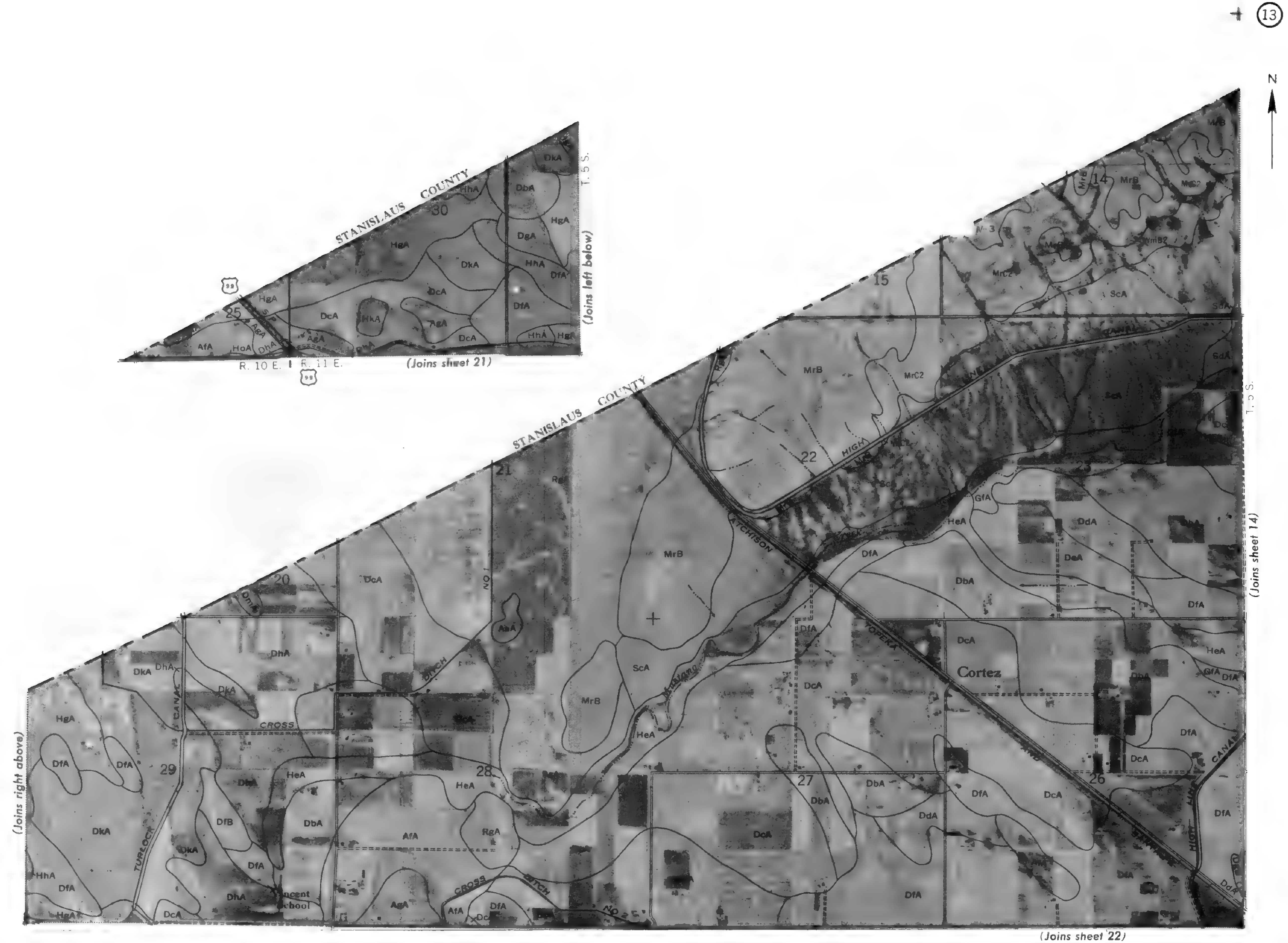
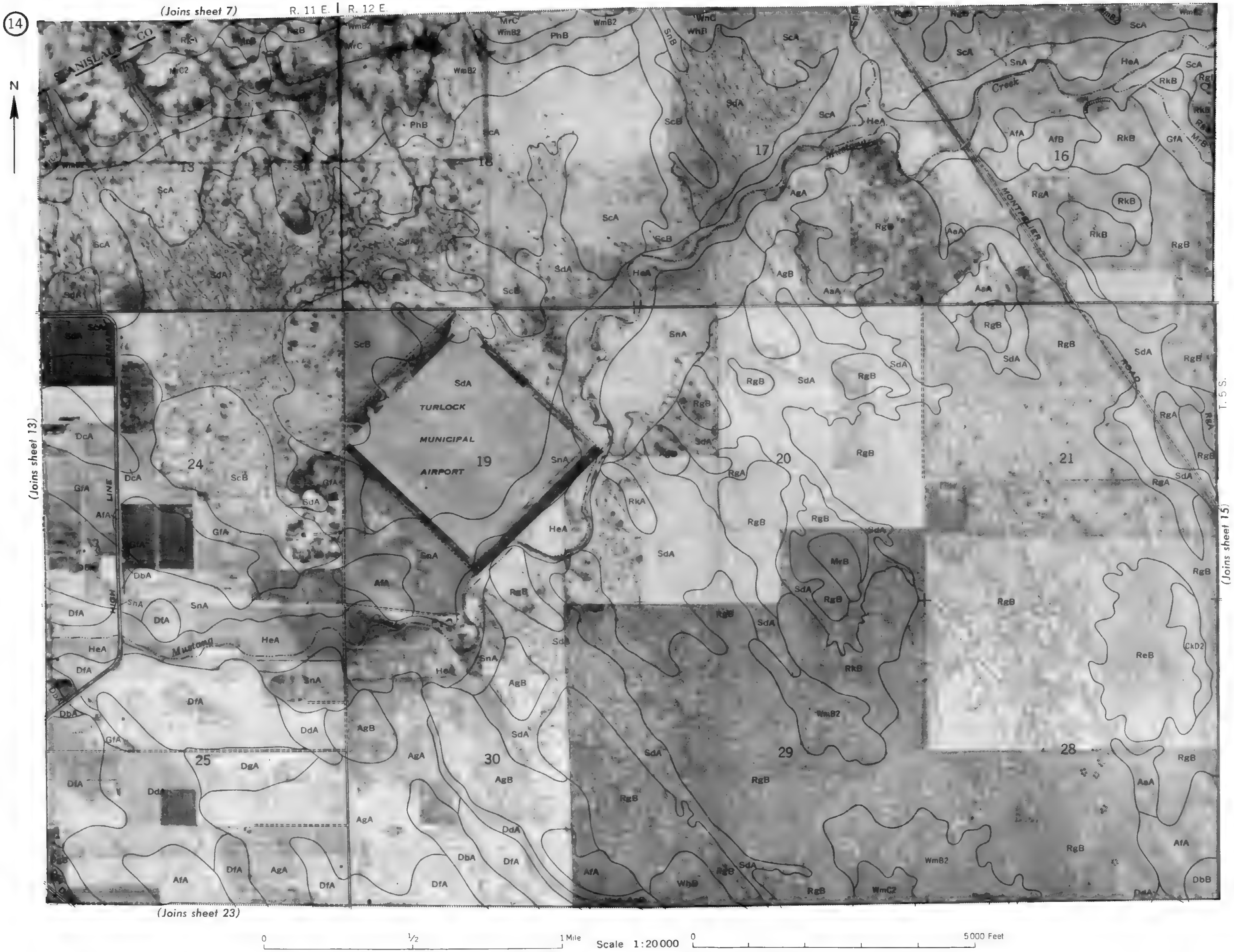
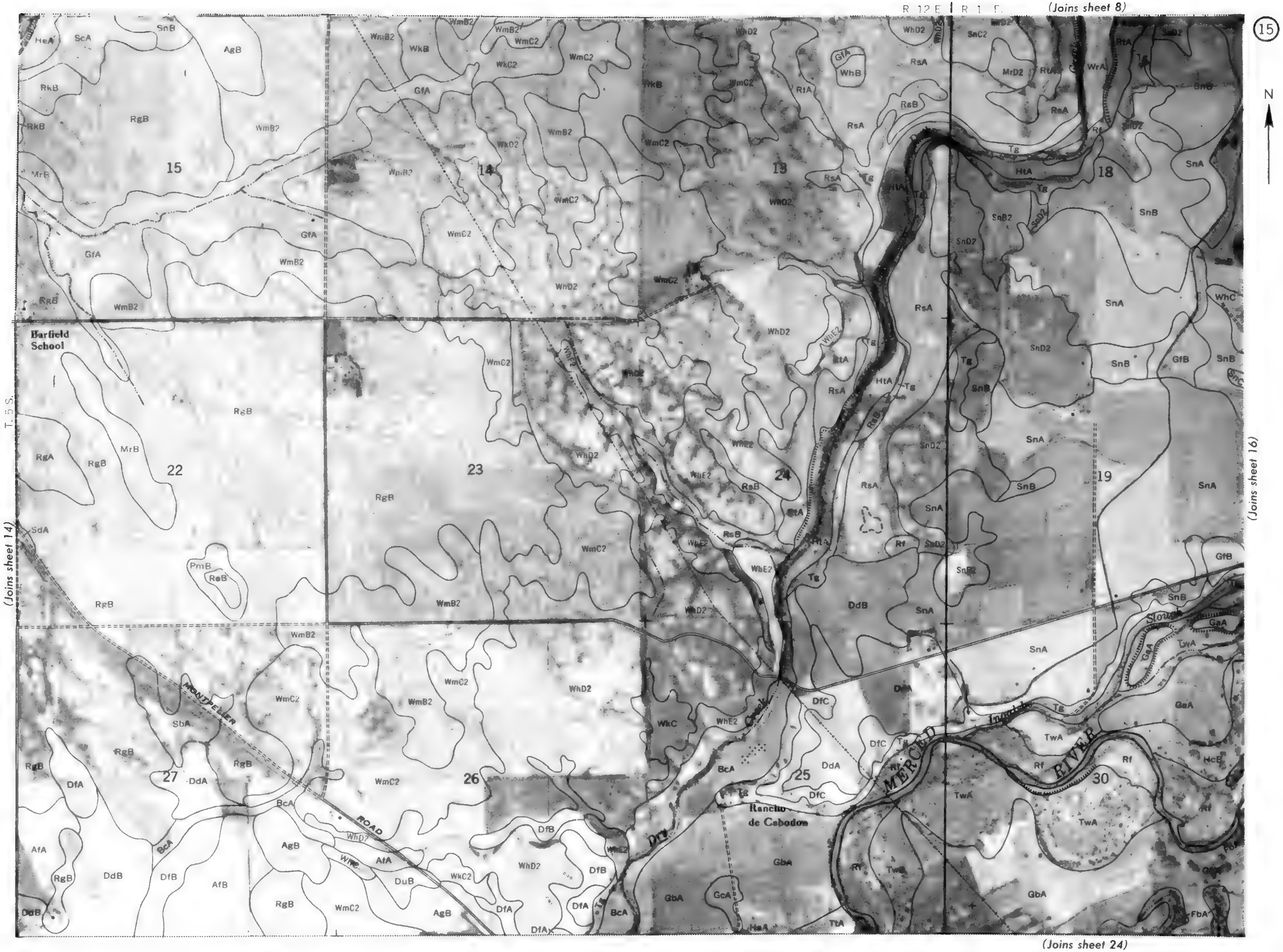


0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 14





0 ½ 1 Mile   Scale 1:20000   0 5000 Feet

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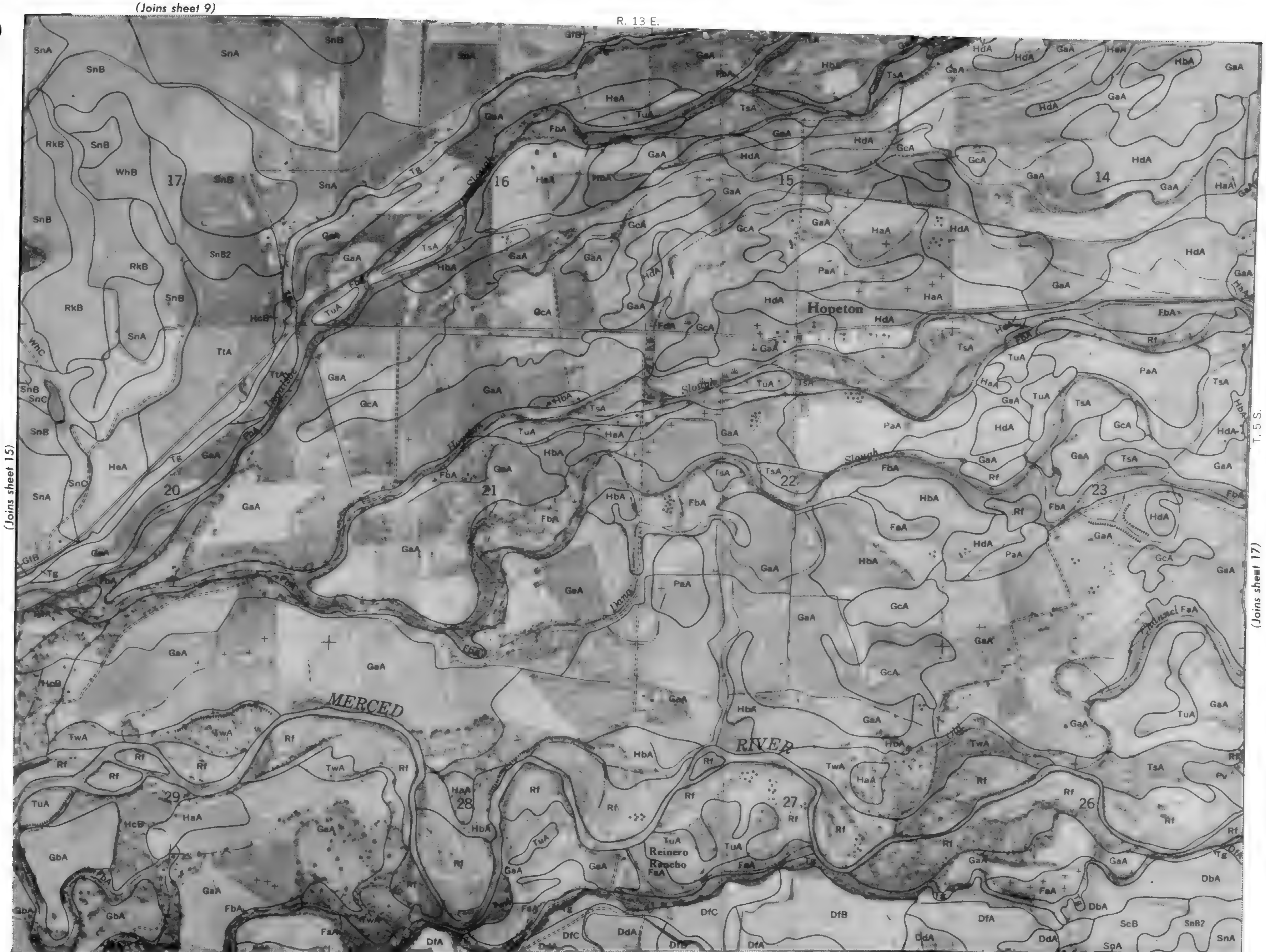
Range, township, and section corners shown on this map are indefinite.

16

(Joins sheet 9)

N

(Joins sheet 15)

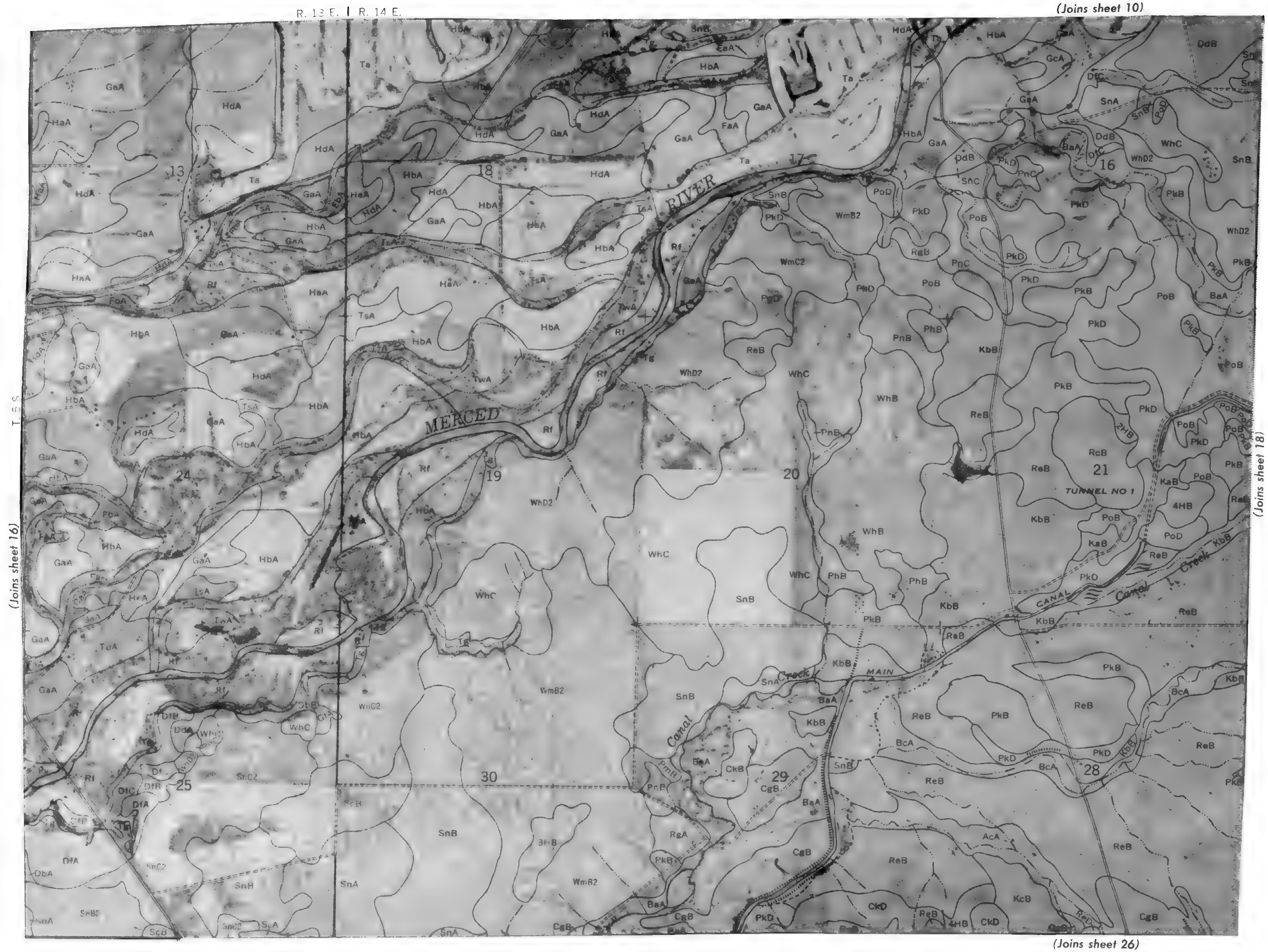


(Joins sheet 17)

(Joins sheet 25)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

17



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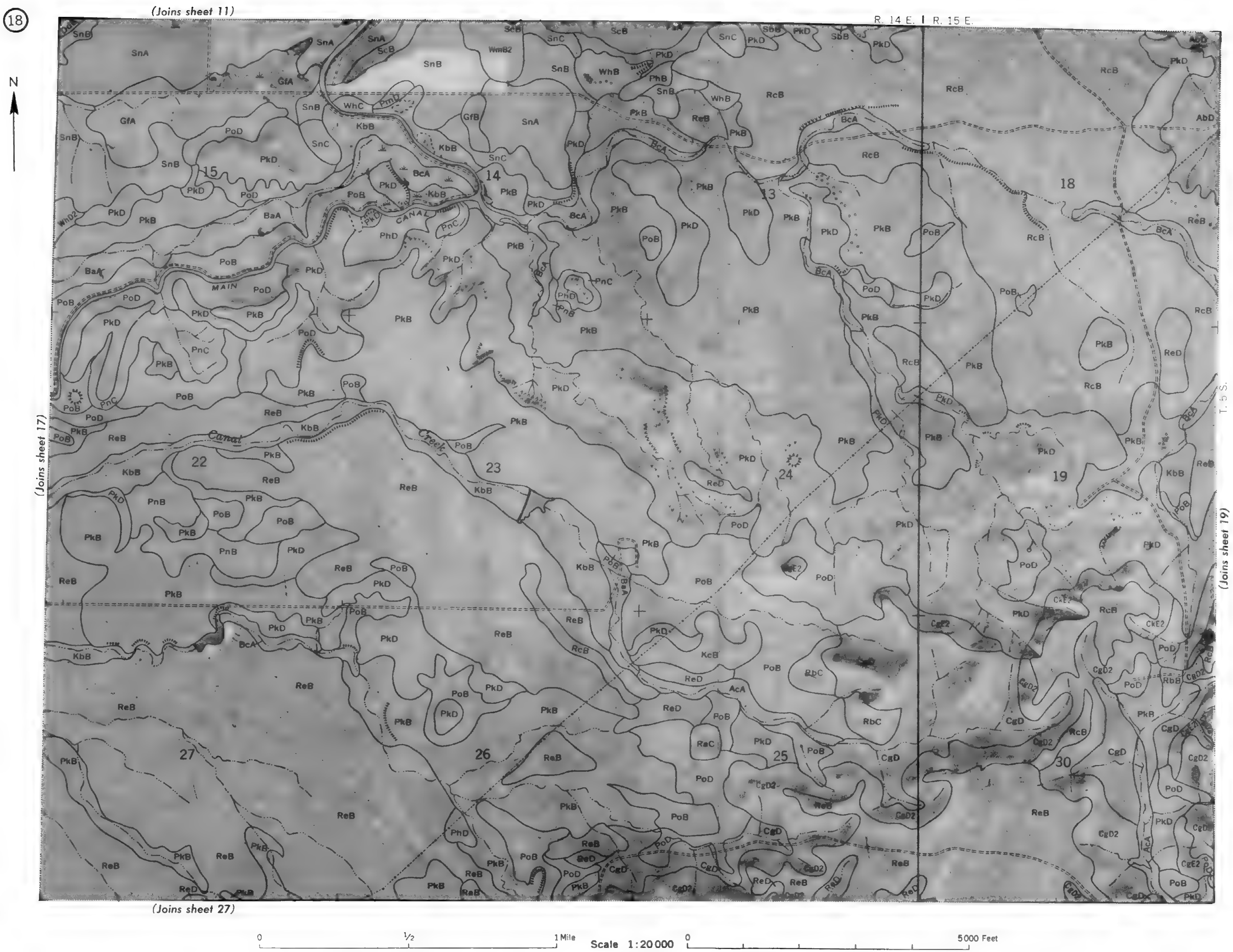
0 ½ 1 Mile Scale 1:20000 0 5000 Feet



Scale 1:20 000

19

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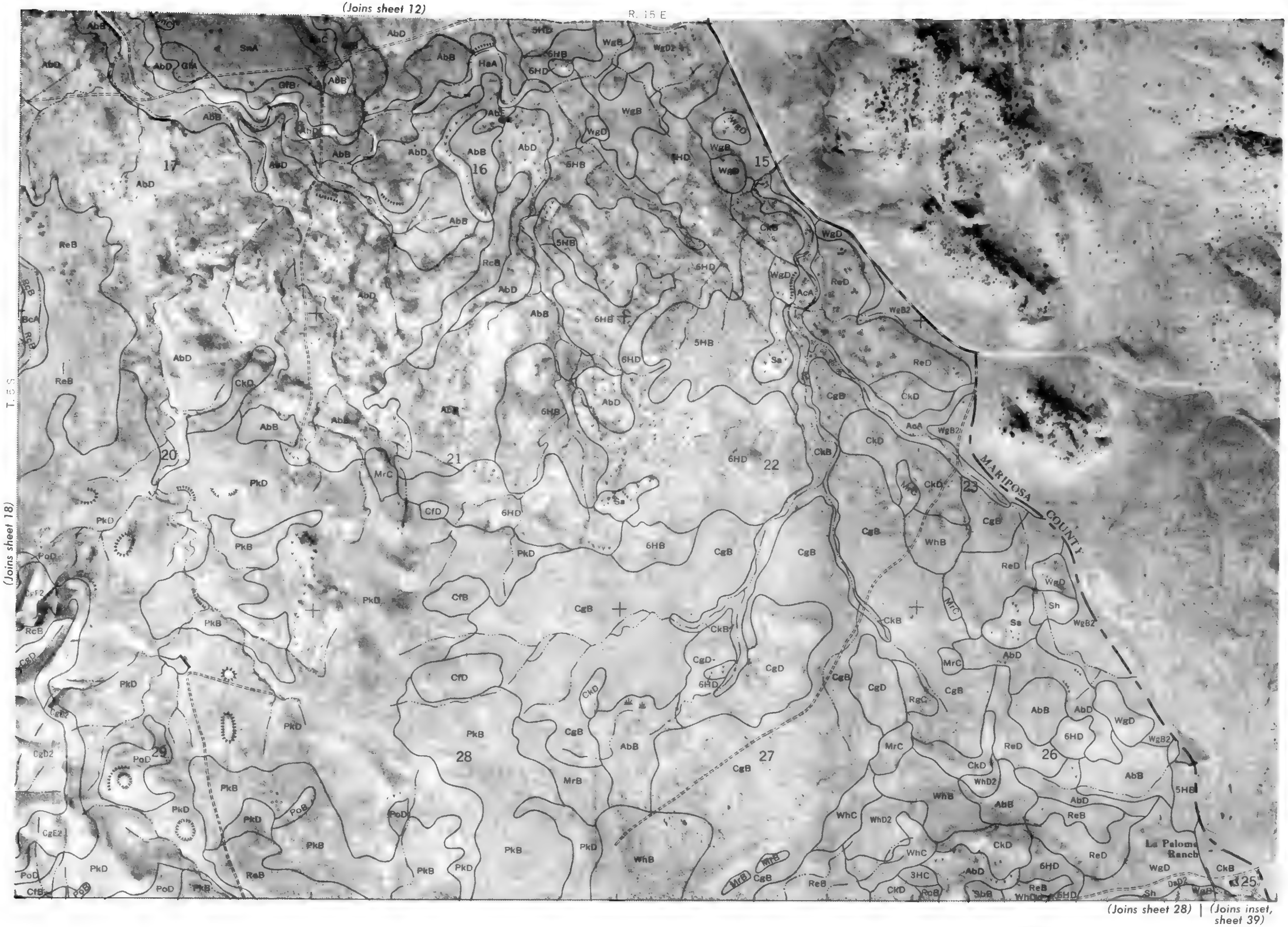
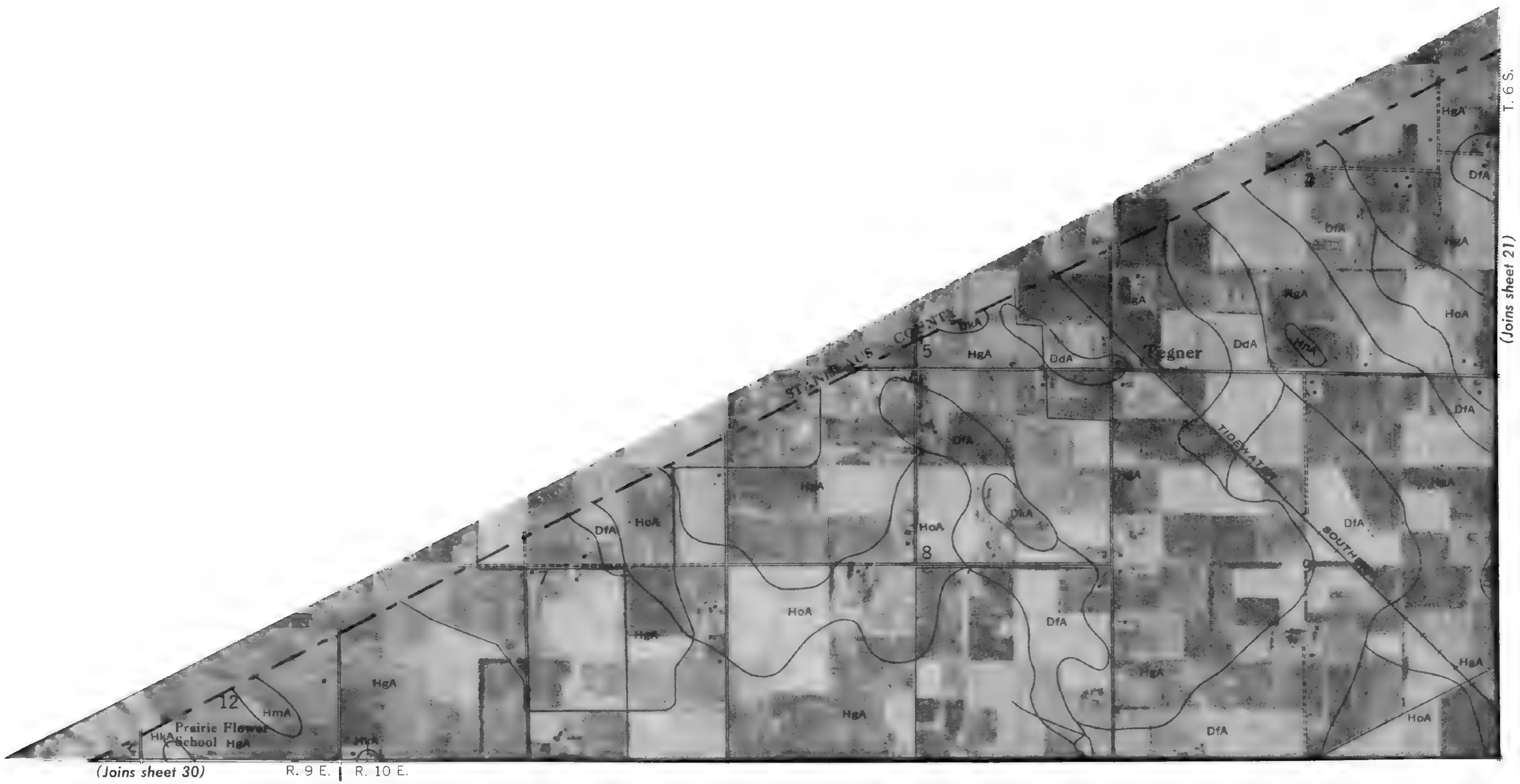


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

20

N



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

(22)

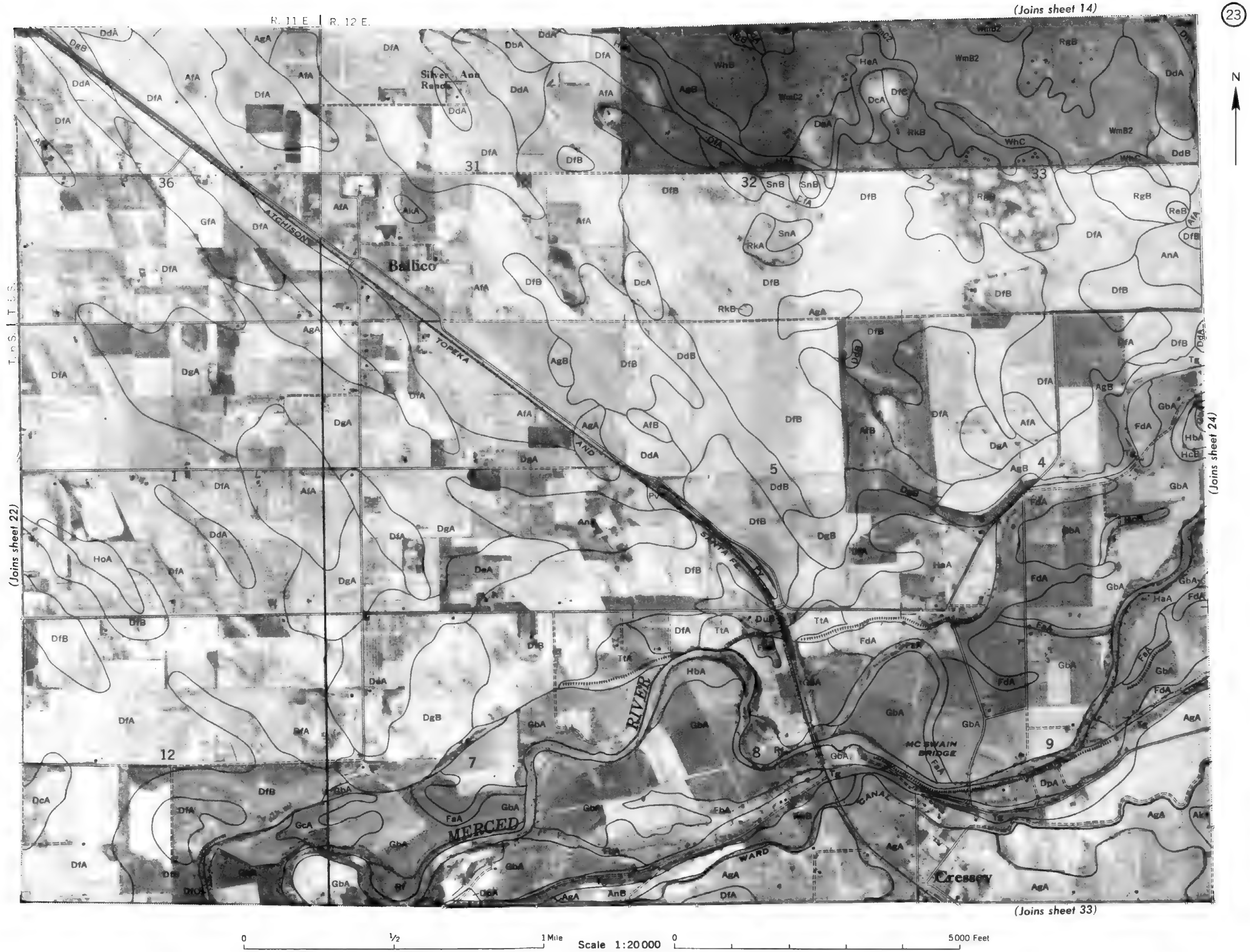
(Joins sheet 13)

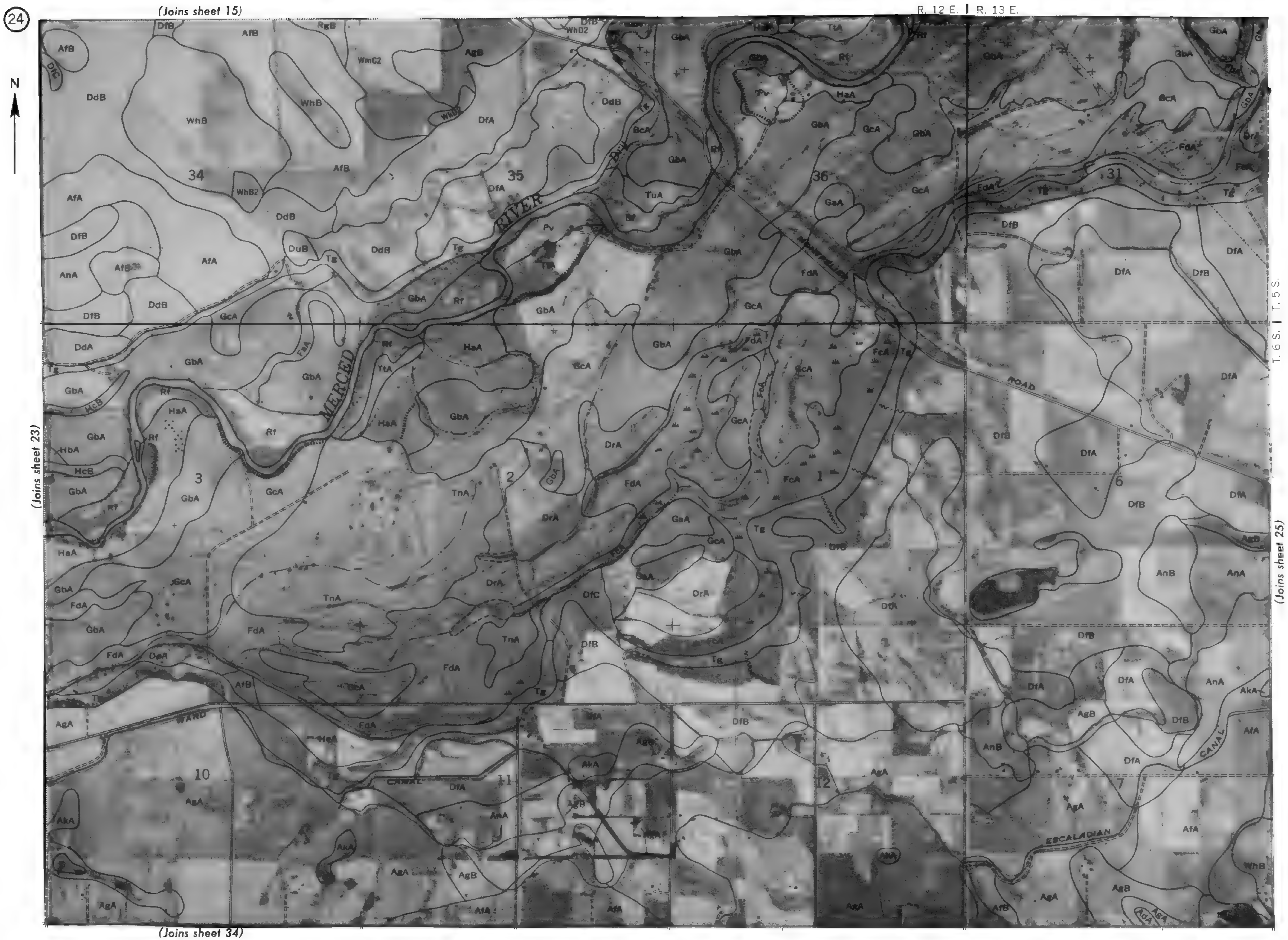
(Joins sheet 32)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a [illegible] survey report of the [illegible] mation regarding the complete [illegible] survey report, write the Soil Conservation Service, U. S. Department [illegible] compiled from aerial photographs flown in [illegible].

Range, township, and section corners shown on this map are indefinite.





Scale 1:20 000
0 ½ 1 Mile
0 5 000 Feet

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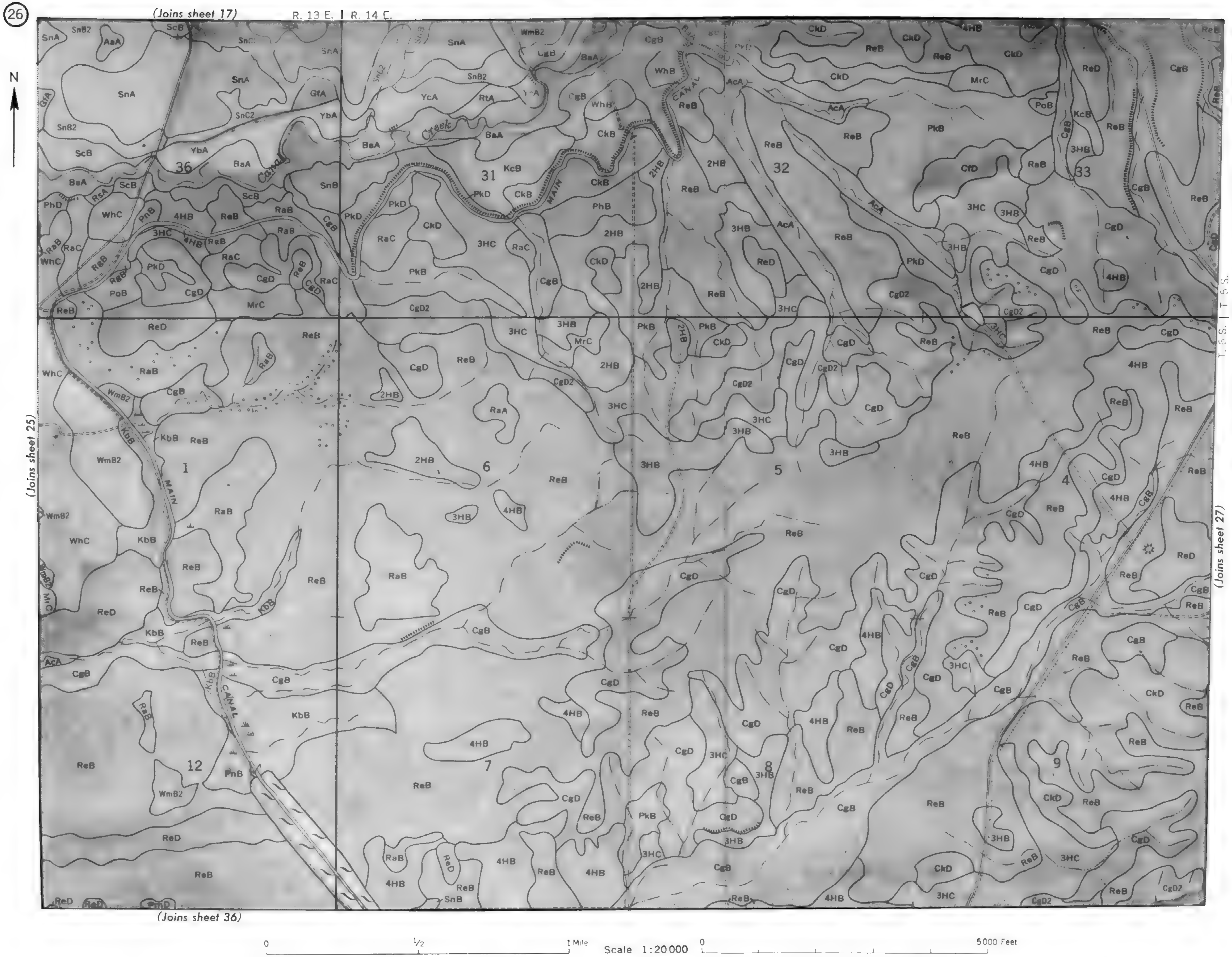
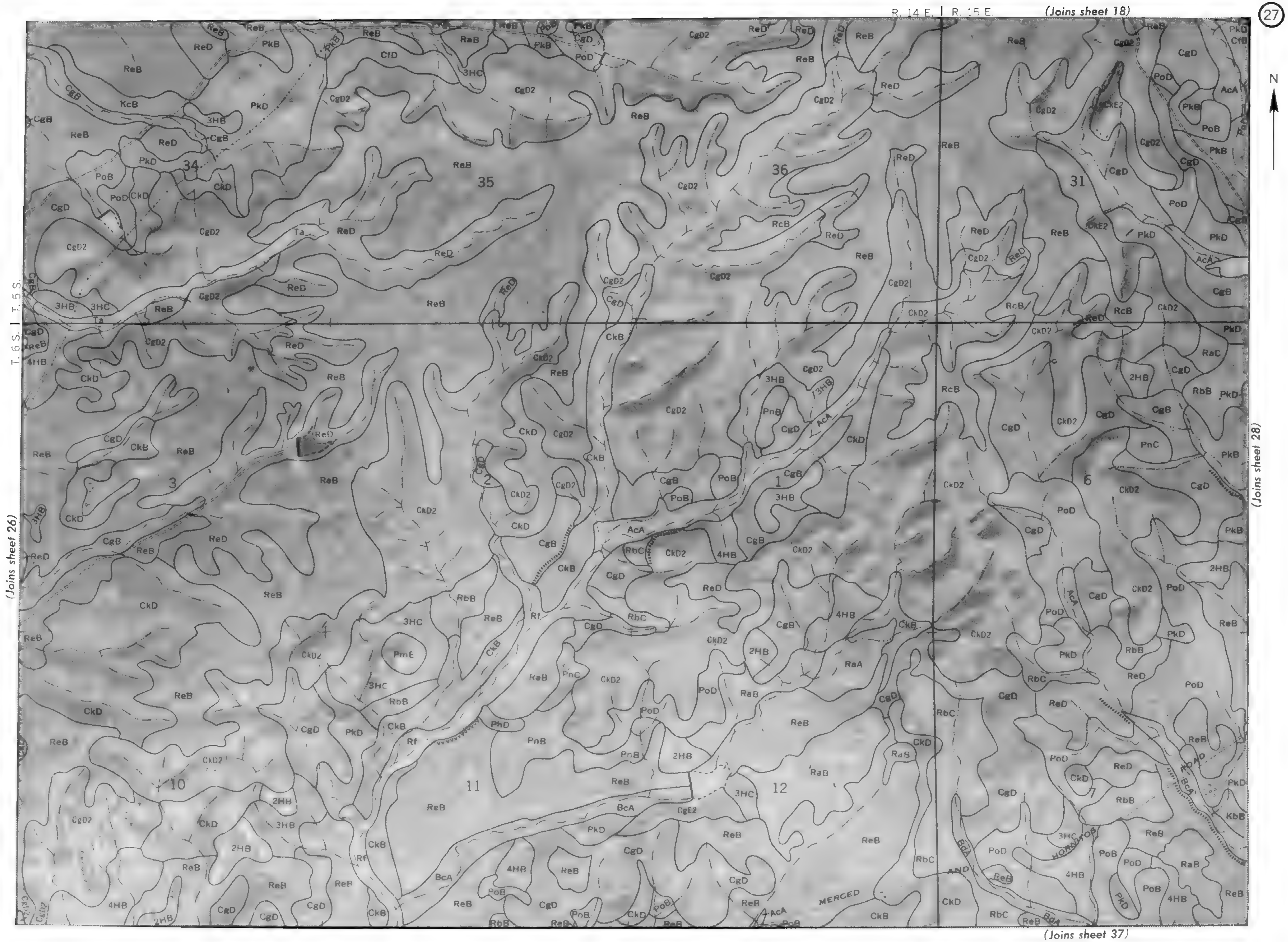

26
(Joins sheet 17)
R. 13 E. | R. 14 E.
N
(Joins sheet 25)
(Joins sheet 27)
T. 5 S. | T. 6 S.
(Joins sheet 36)
0 1/2 1 Mile
Scale 1:20000
0 5000 Feet



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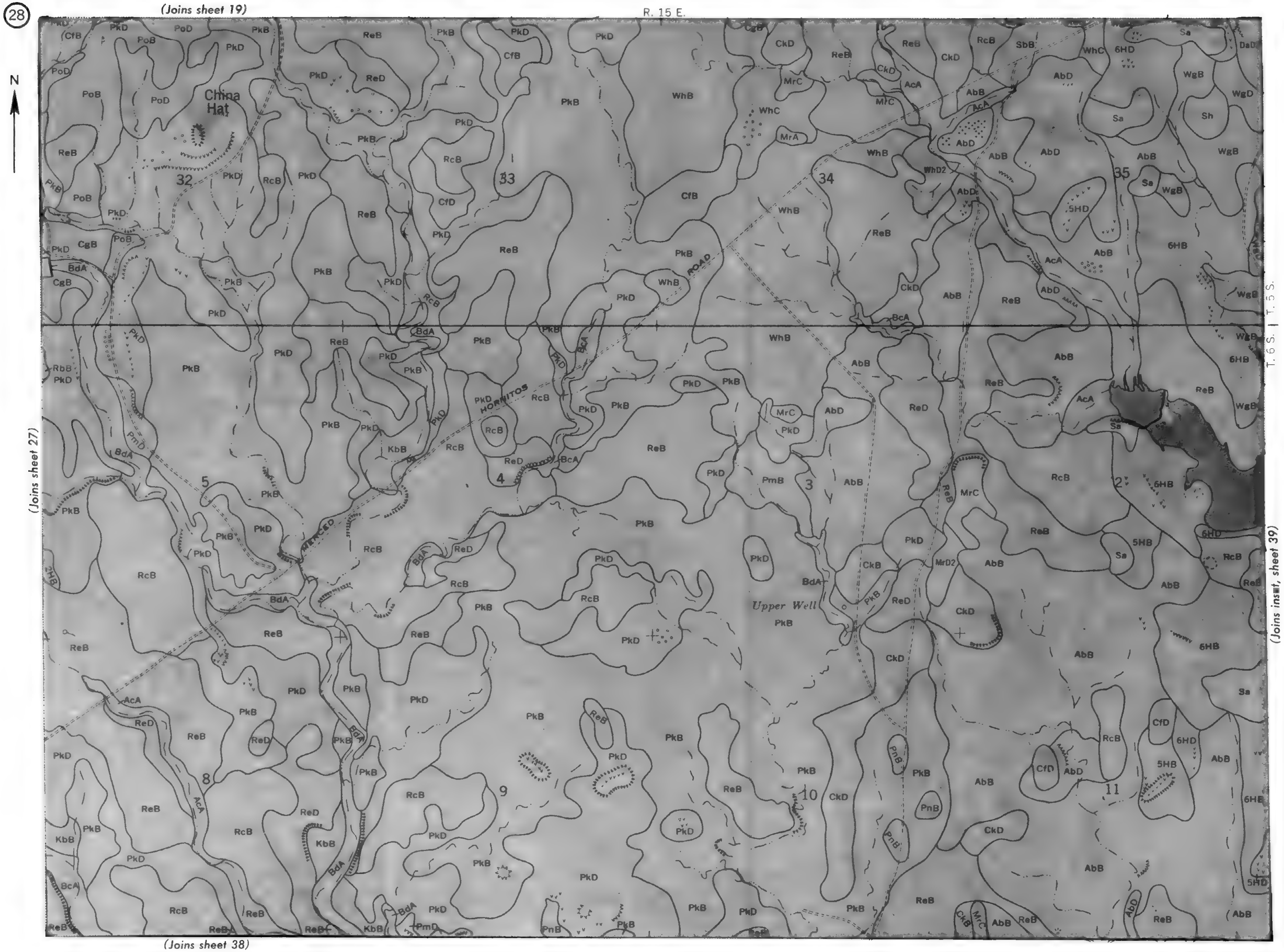
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



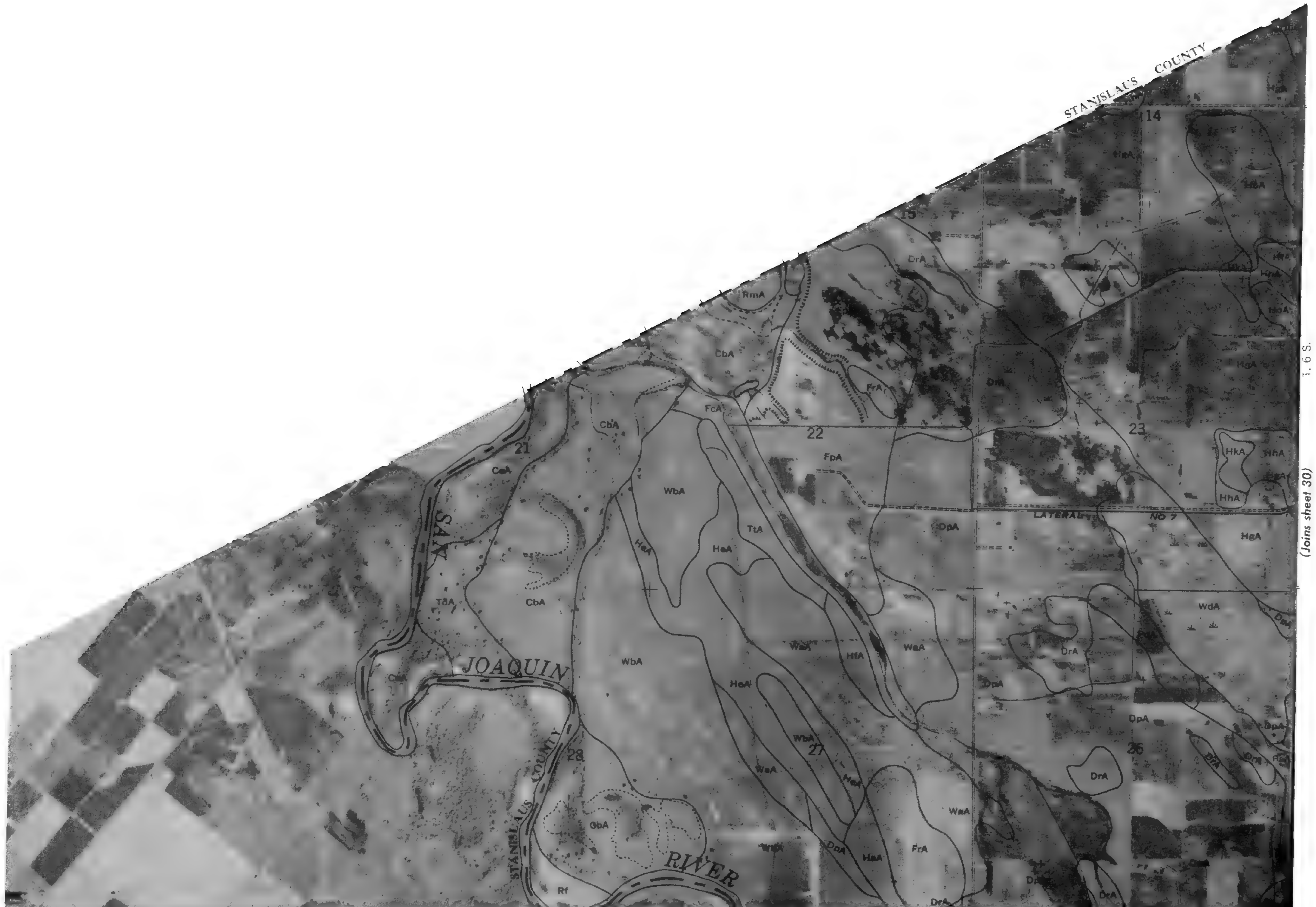
Scale 1:20000

0 ½ 1 Mile

0 5000 Feet

R. 9 E

29



T. 6 S.

(Joins sheet 30)

(Joins sheet 40)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950

Range, township, and section corners shown on this map are indefinite.


30
(Joins sheet 20)
R. 9 E.
R. 10 E.
N
(Joins sheet 29)
(Joins sheet 31)
T. 6 S.
(Joins sheet 41)
STANISLAUS
STEVINSON
LATERAL
NO 7
LOWER
Fairview School
Riverside School
Berea Church
13
18
16
24
19
20
21
25
30
29
28
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 32

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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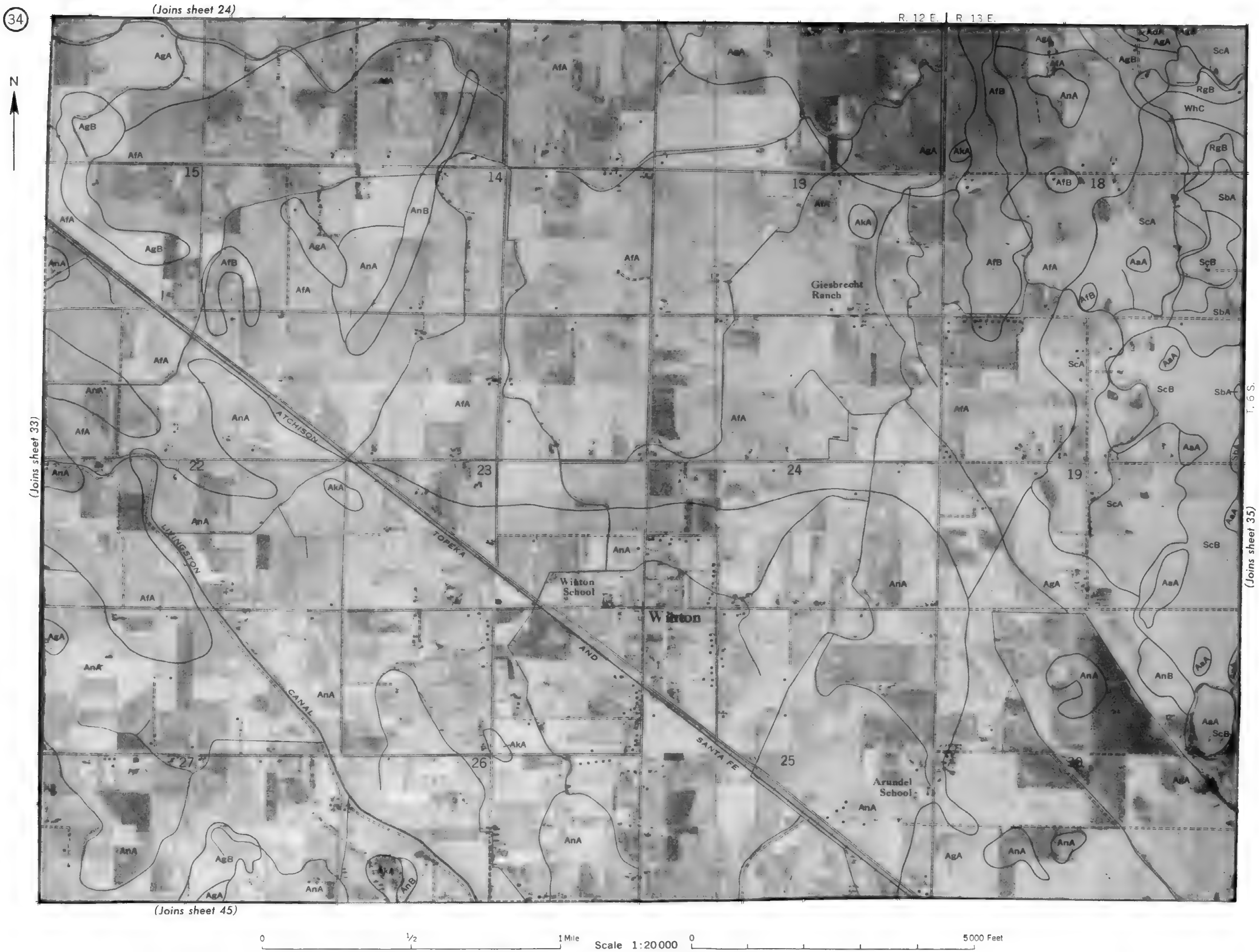
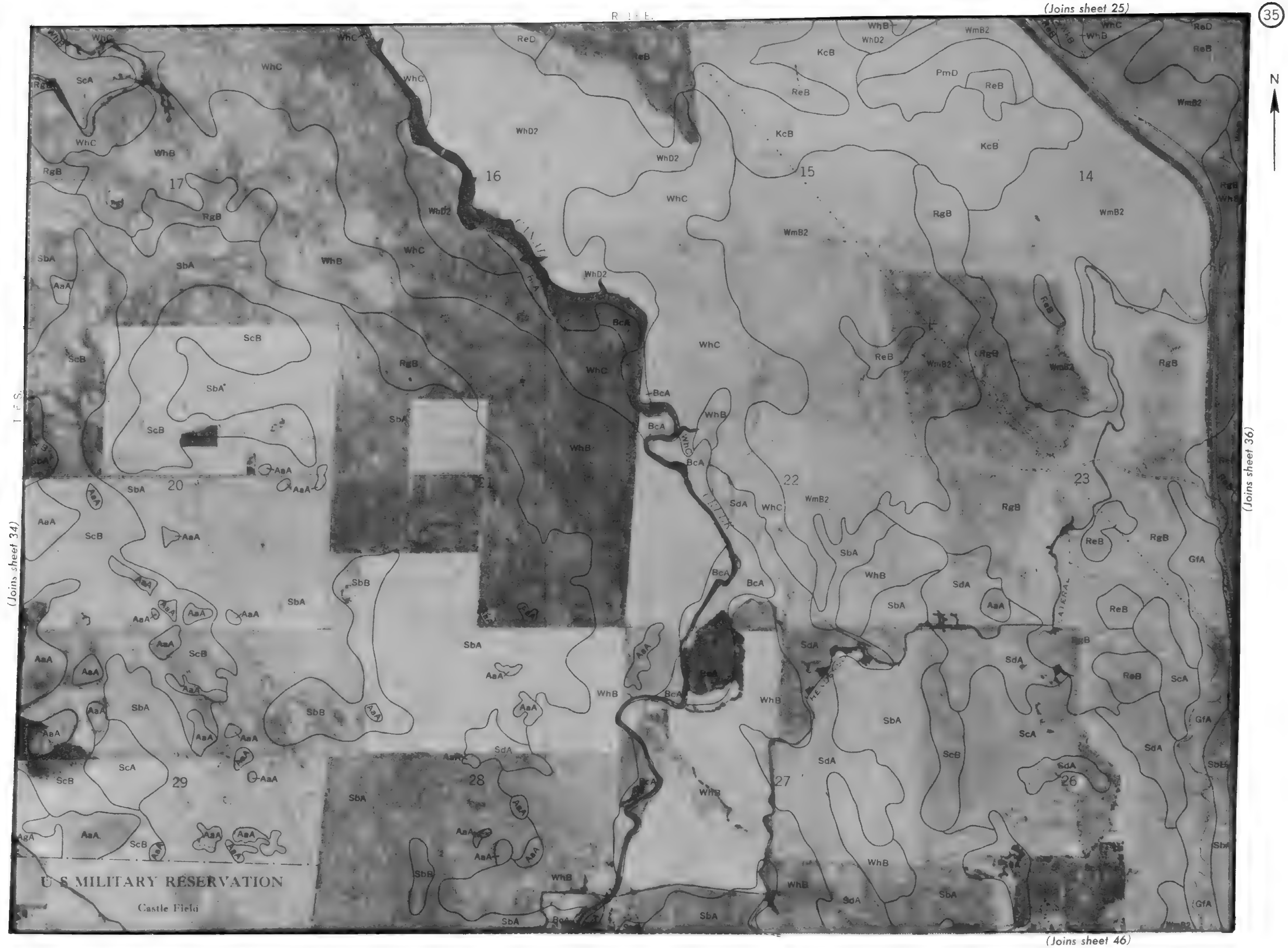
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

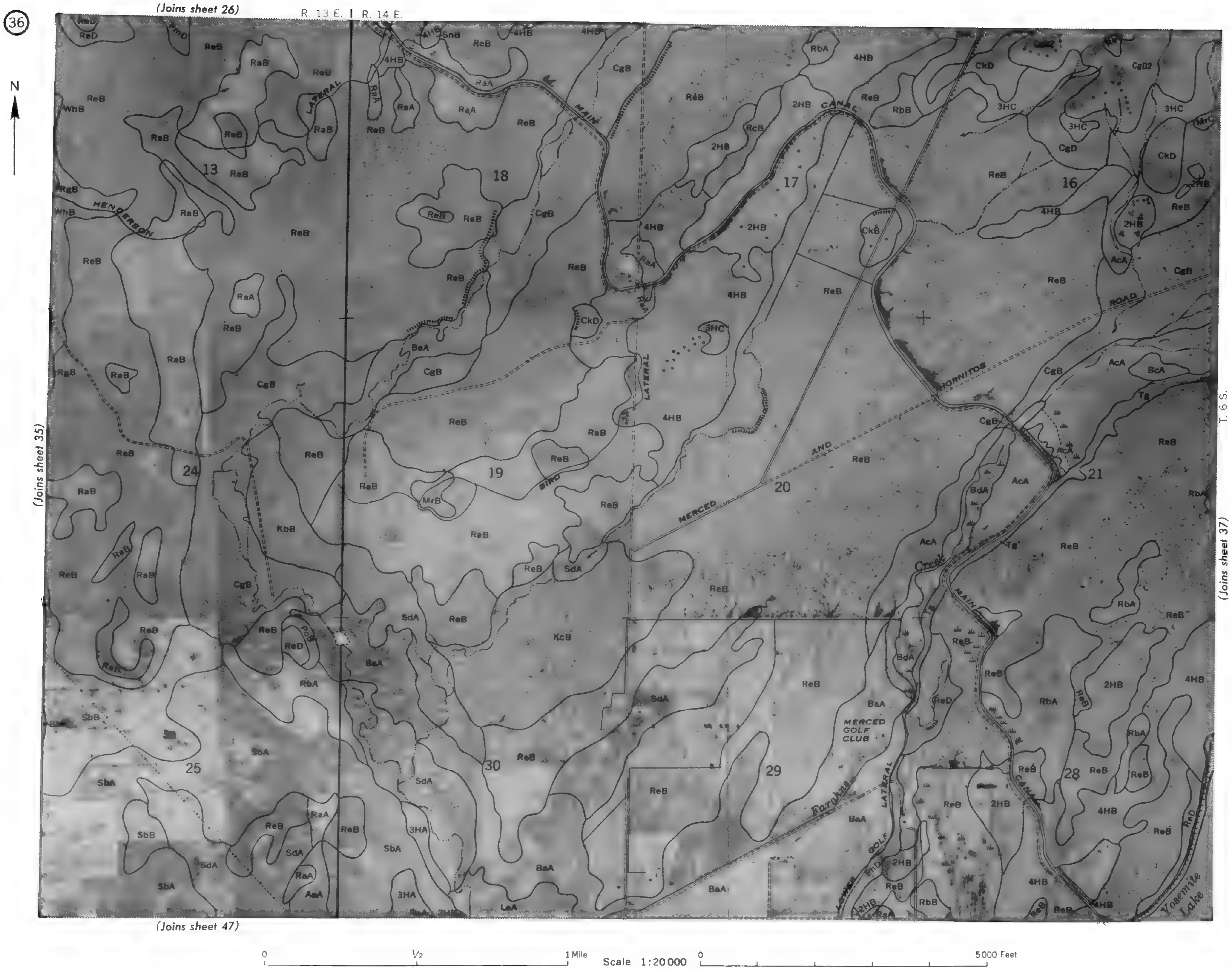

34
(Joins sheet 24)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 45)
N
R. 12 E.
R. 13 E.
T. 6 S.
15
14
13
18
22
23
24
19
27
26
25
30
ATCHISON
TOPEKA
AND
SANTA FE
LIVINGSTON
CANAL
Giesbrecht
Ranch
Winton
School
Winton
Arundel
School
AgA
AgB
AfA
AfB
AnA
AnB
AkA
AaA
ScA
ScB
SbA
RgB
WhC
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

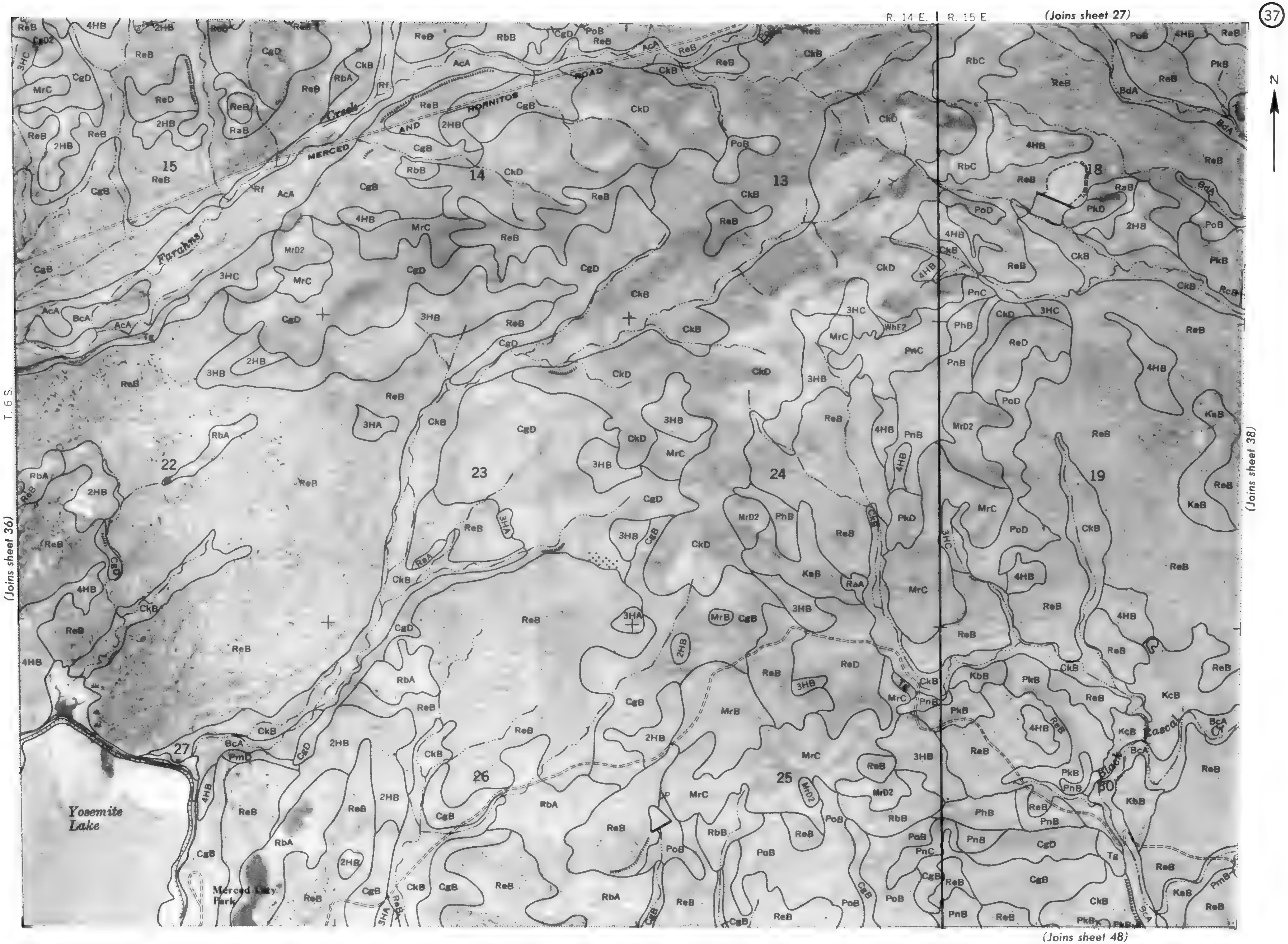


0 1/2 1 Mile Scale 1:20 000 5000 Feet


36
N
(Joins sheet 26)
R. 13 E.
R. 14 E.
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 47)
T. 6 S.
13
16
17
18
19
20
21
24
25
28
29
30
HENDERSON
LATERAL
MAIN
CANAL
HORNITOS
ROAD
MERCED
AND
BIRD
Creek
MERCED GOLF CLUB
LOWER GOLF LATERAL
Fahrens
Yosemite Lake
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1962.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

(Joins right below)

(Joins sheet 38)

T. 6 S.

R. 15 E. | R. 16 E.

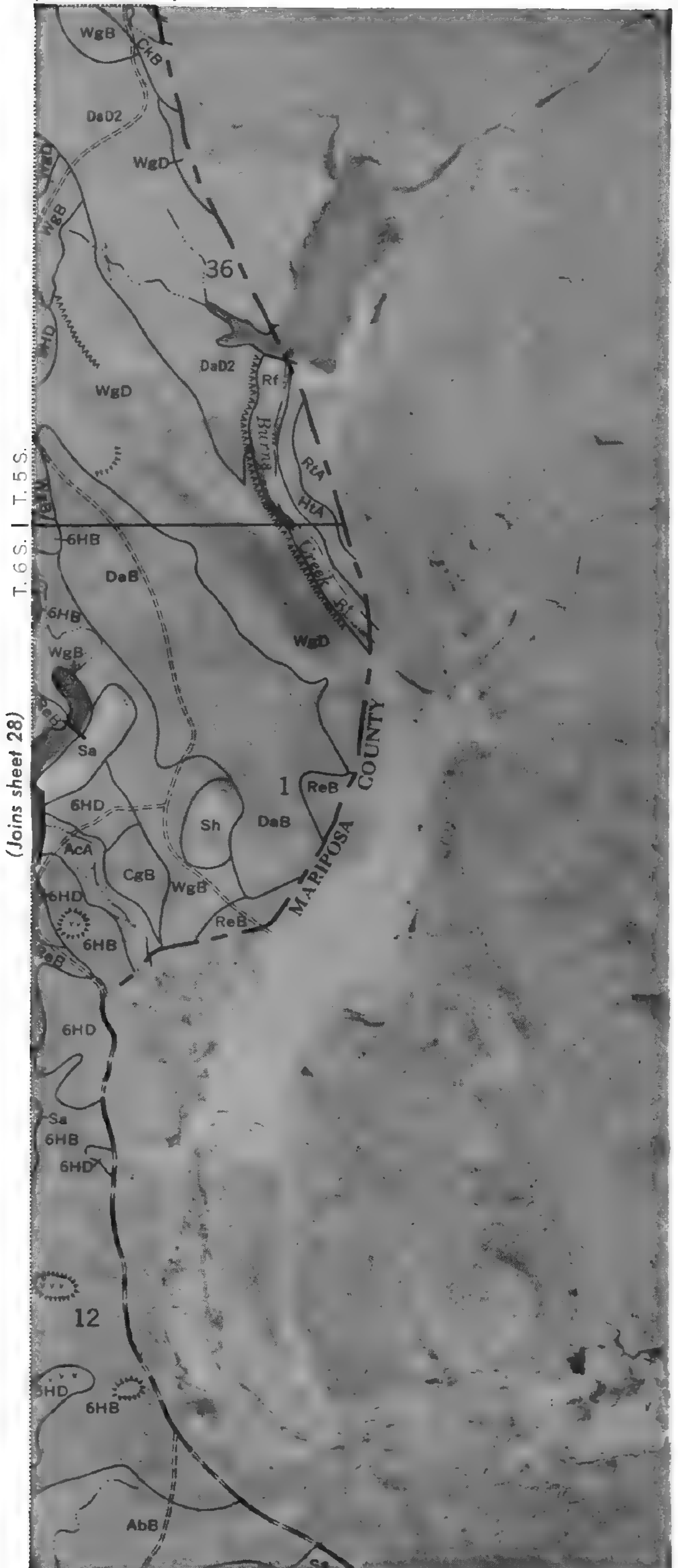
(Joins sheet 50)

(Joins sheet 19)

(Joins sheet 28)

T. 5 S.

T. 6 S.



(Joins left above)

R. 15 E.

39

Scale 1:20000

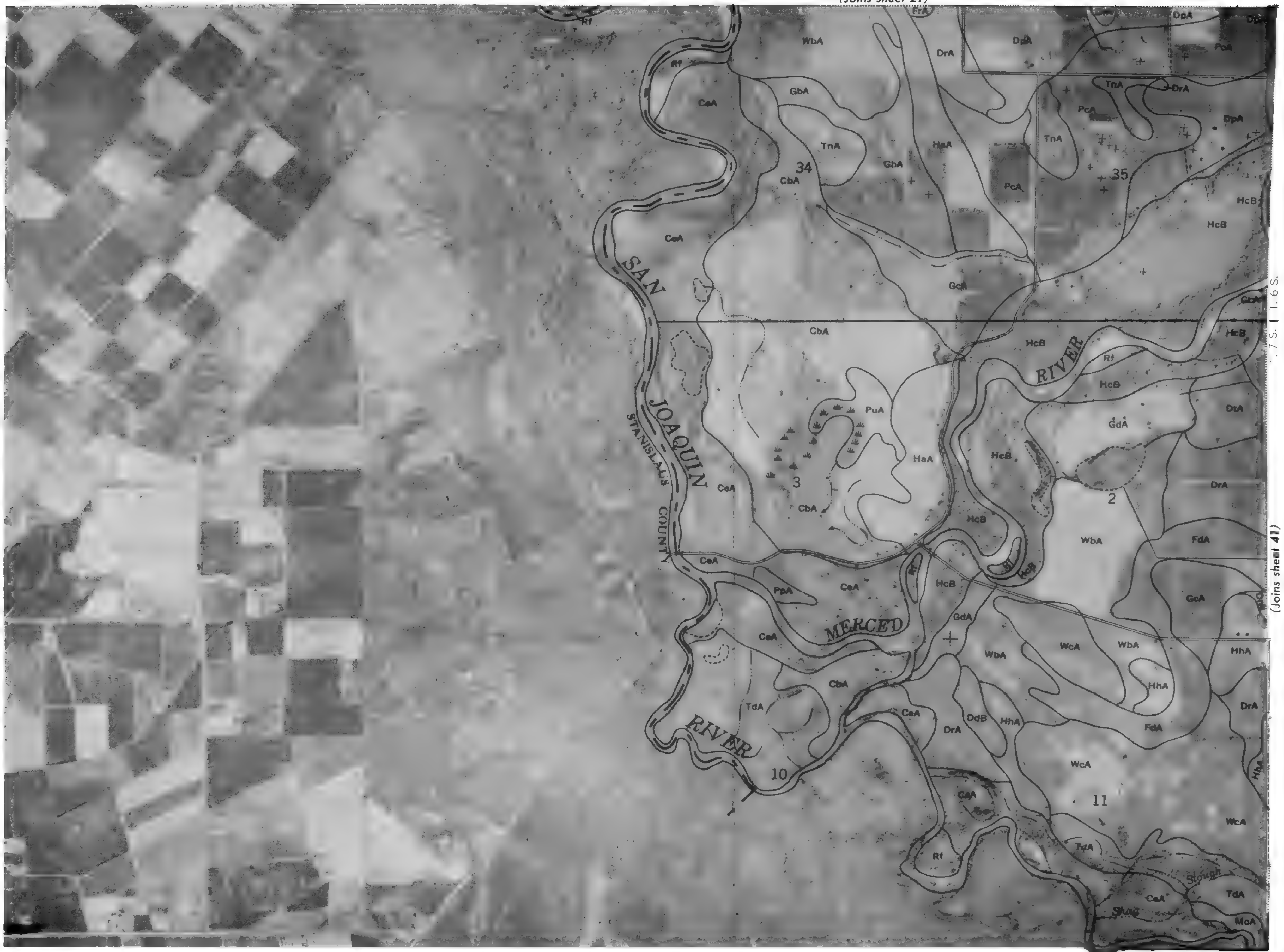
0 ½ 1 Mile

0 5000 Feet

40

R. 9 E.

(Joins sheet 29)



(Joins sheet 51)

Scale 1:20 000

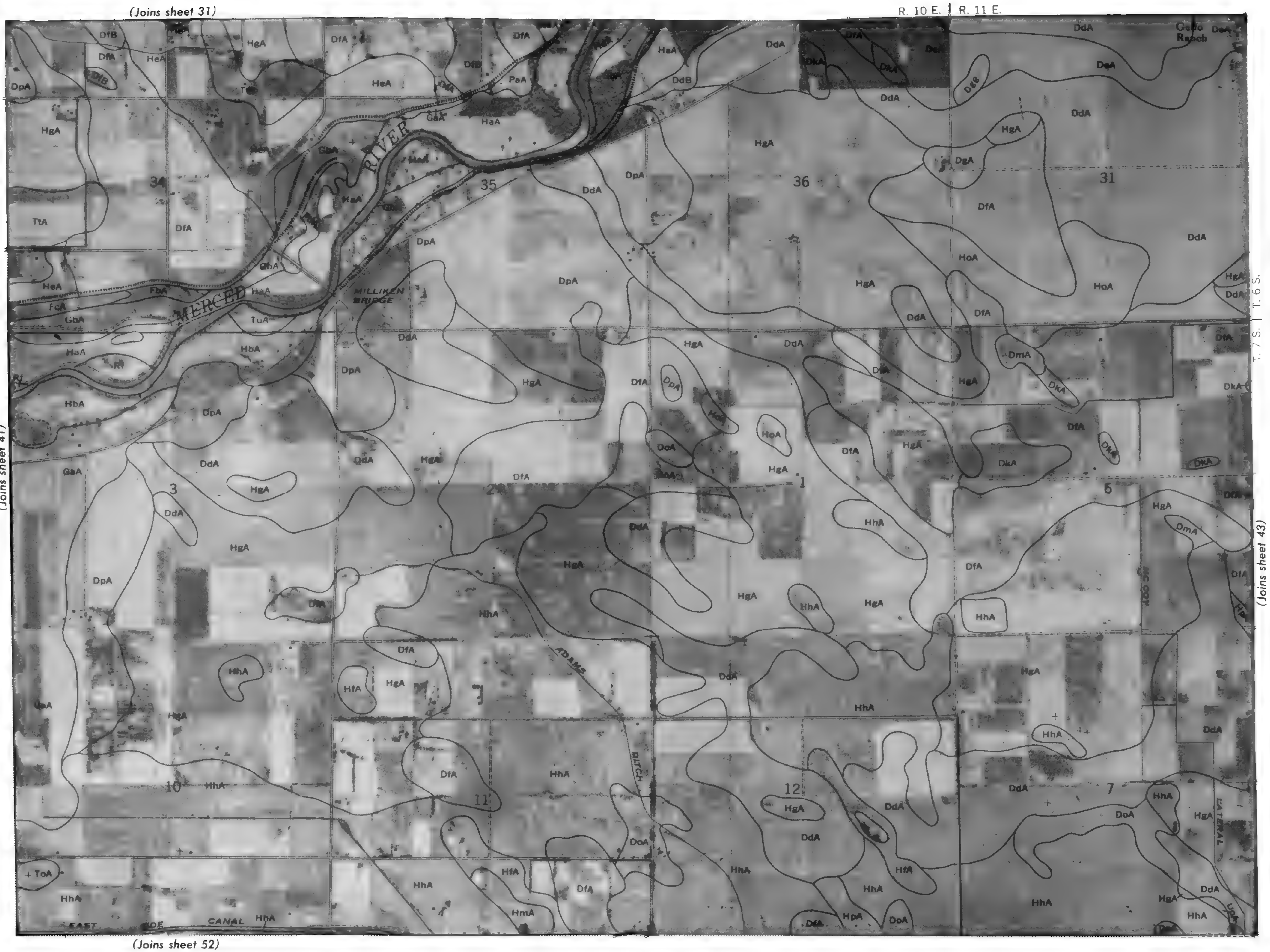
0 ½ 1 Mile

0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs taken in 1950.

Range, township, and section corners shown on this map are indefinite.

42



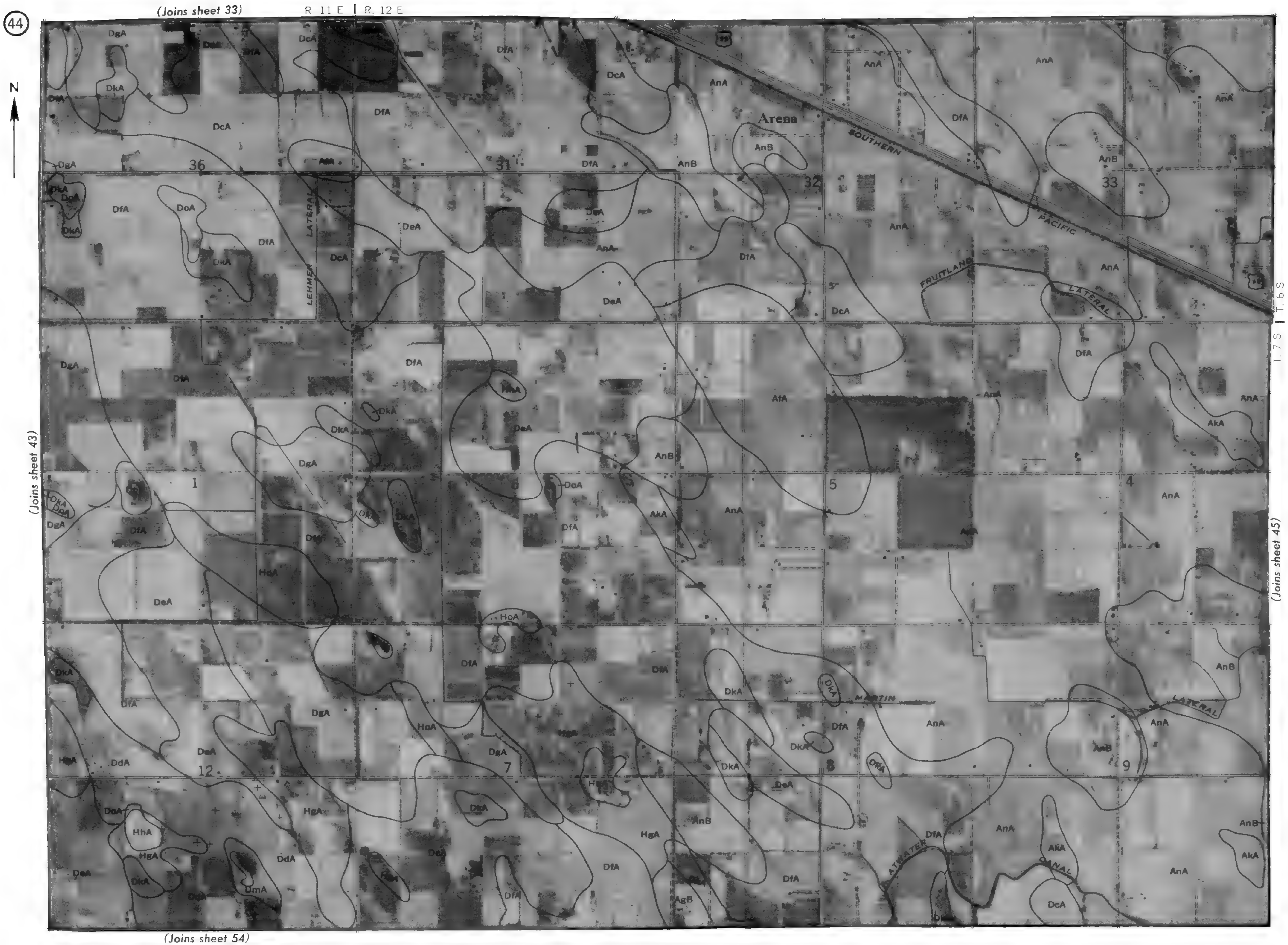
Scale 1:20000

0 ½ 1 Mile

0 5000 Feet

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

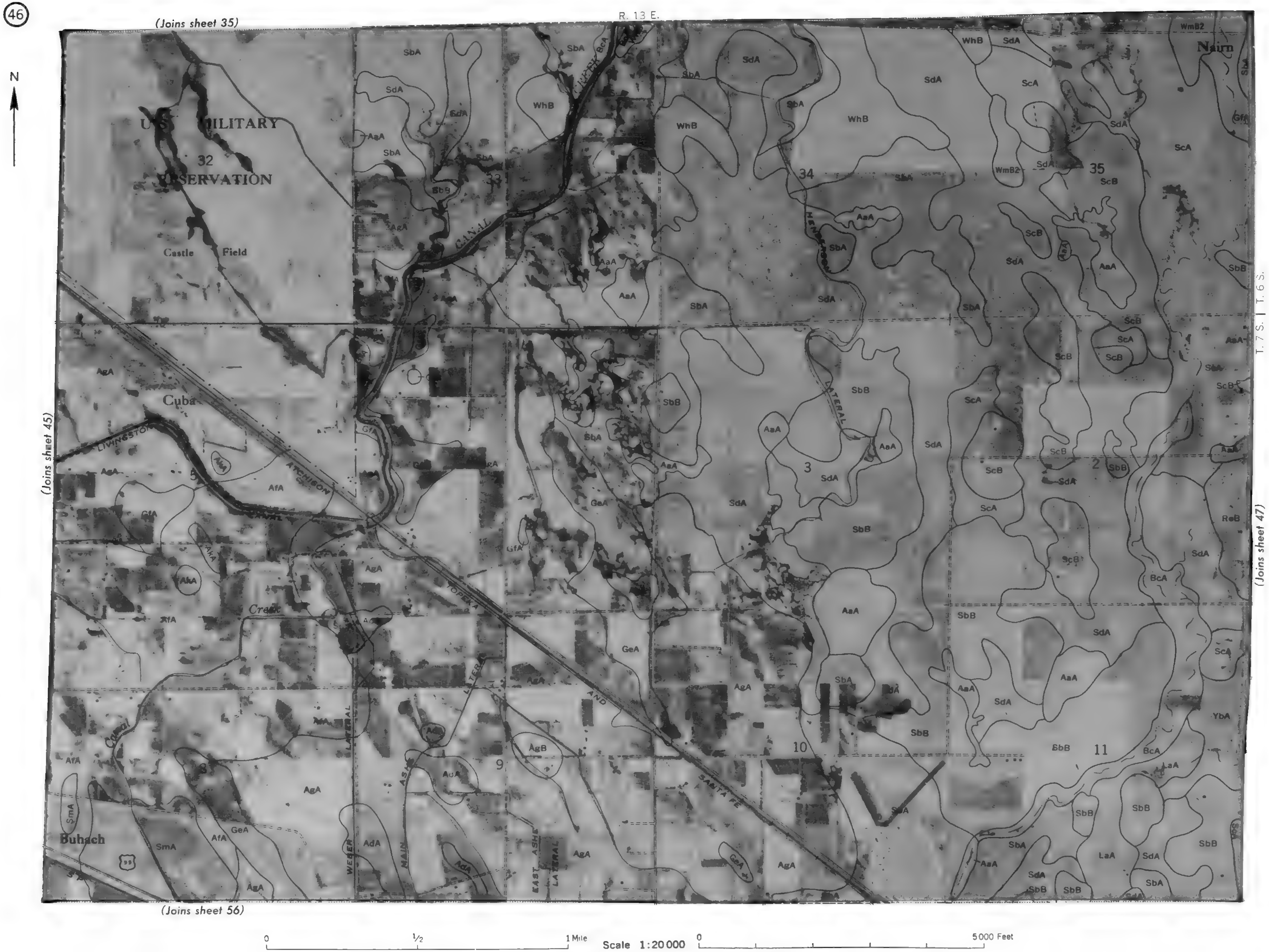


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

0 — 1/2 — 1 Mile   Scale 1:20 000   0 — 5000 Feet


46
(Joins sheet 35)
R. 13 E.
N
U.S. MILITARY
32
RESERVATION
Castle Field
Cuba
Nairn
Buhach
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 56)
T. 6 S.
T. 7 S.
33
34
35
3
2
10
11
9
5
8
CANAL
LATERAL
Creek
ATCHISON
TOPEKA
AND
SANTA FE
WEBER
MAIN
EAST
LATERAL
SbA
SdA
WhB
ScA
ScB
SbB
AaA
AgA
AfA
GfA
GeA
AgB
AdA
SmA
BcA
LaA
ReB
YbA
WmB2
Scale 1:20 000
0
½
1 Mile
0
5000 Feet

(Joins sheet 36)

47

(Joins sheet 57)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

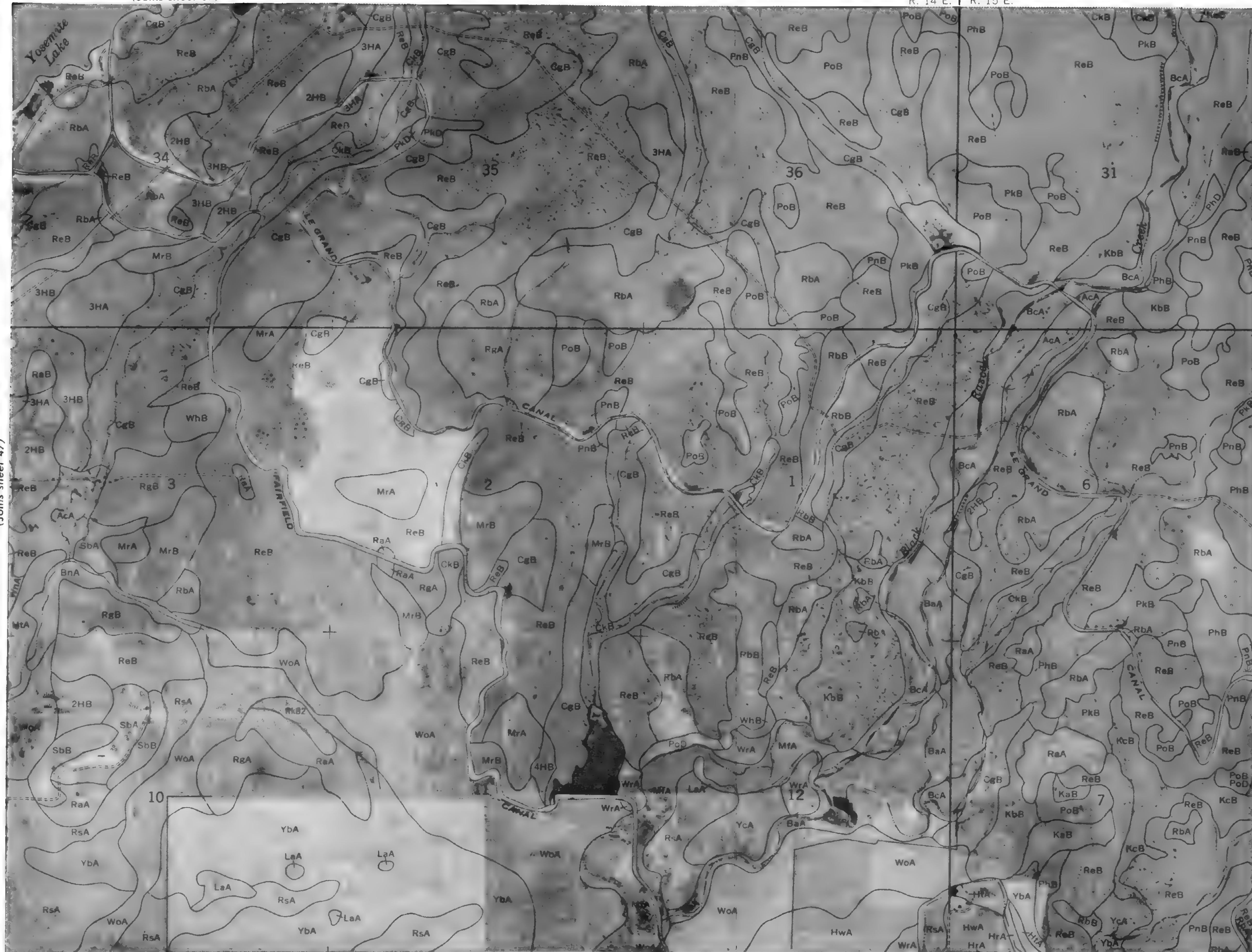
MERCED AREA, CALIFORNIA - SHEET NUMBER 48

(48)

(Joins sheet 37)

R. 14 E. | R. 15 E.

N



(Joins sheet 47)

T. 6 S. | T. 7 S.

(Joins sheet 49)

(Joins sheet 58)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

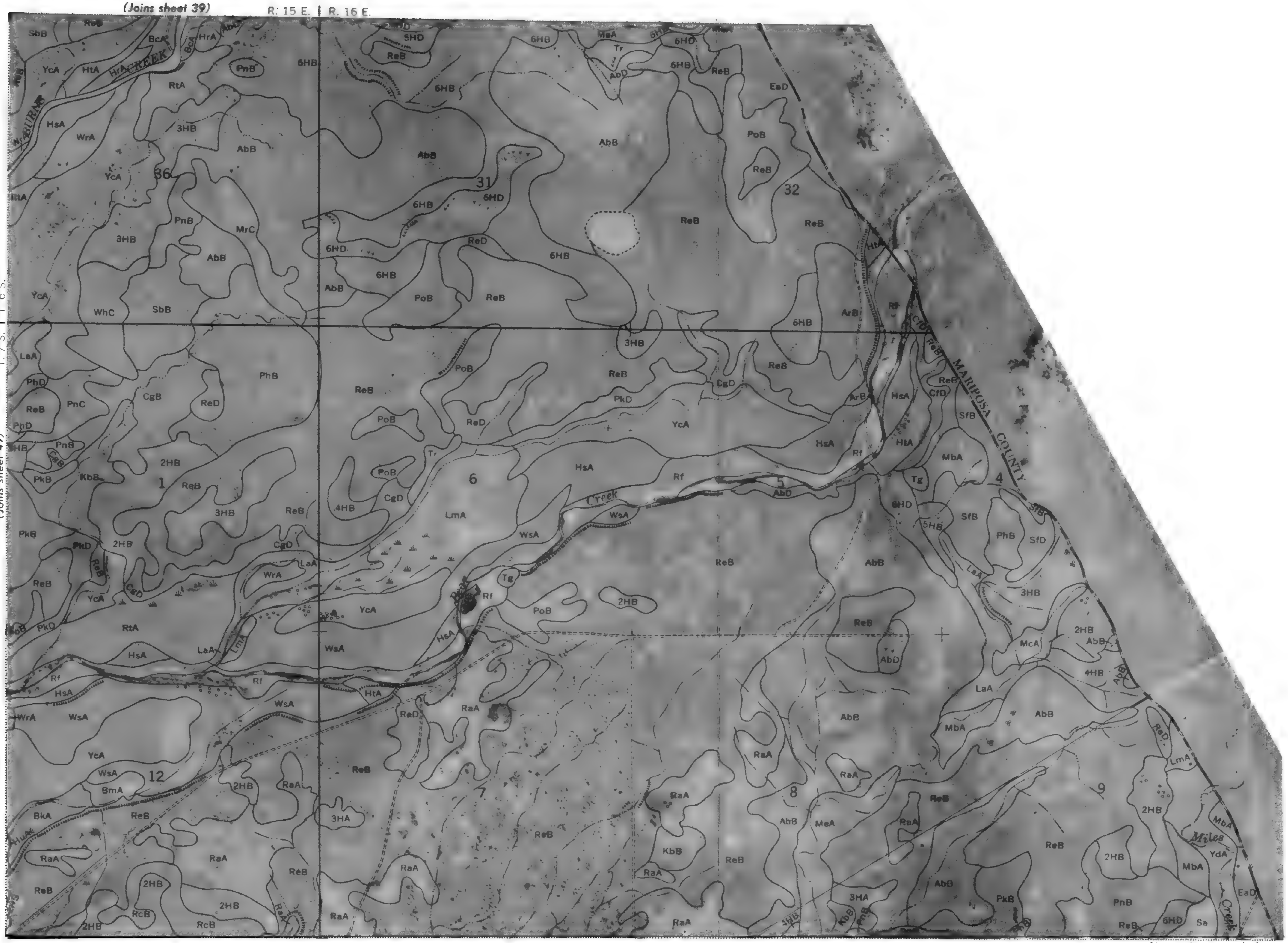
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington, D. C. This map compiled from aerial photographs flown in 19[illegible].

Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 50

50

(Joins sheet 39)



(Joins sheet 60) | (Joins inset, sheet 70)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

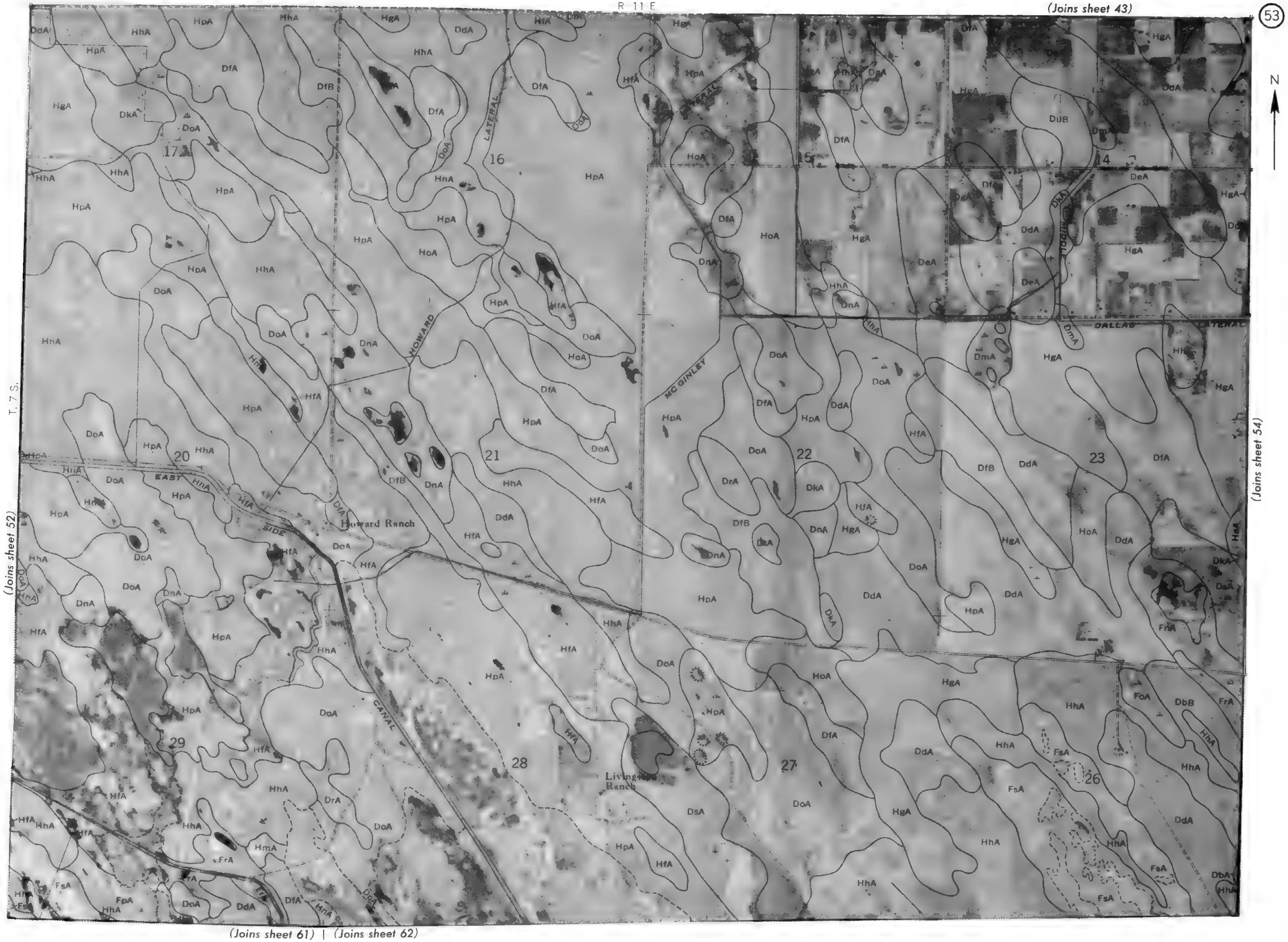
(Joins sheet 40) | (Joins sheet 41)

Range, township, and sect on corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 52

0 1/2 1 Mile Scale 1:20000 0 5000 Feet



0 | 1/2 | 1 Mile | Scale 1:20000 | 0 | 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 13[illegible].

Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 54

54

(Joins sheet 44)

R. 11 E. | R. 12 E.

N

(Joins sheet 53)

(Joins sheet 55)

(Joins sheet 62) | (Joins sheet 63)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 55

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 56

(Joins sheet 46)

R. 13 E.

56

(Joins sheet 55)

(Joins sheet 57)

(Joins sheet 64) | (Joins sheet 65)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 57

R. 13 E. | R. 14 E.

(Joins sheet 47)

57

(Joins sheet 56)

(Joins sheet 58)

(Joins sheet 65) | (Joins sheet 66)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs taken in 1950.

Range, township, and section corners shown on this map are indefinite

MERCED AREA, CALIFORNIA - SHEET NUMBER 58

(Joins sheet 48)

R. 14 E. | R. 15 E.

58

N

(Joins sheet 57)

(Joins sheet 59)

T. 7 S.

(Joins sheet 66) | (Joins sheet 67)

0 1/2 1 Mile Scale 1:20000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

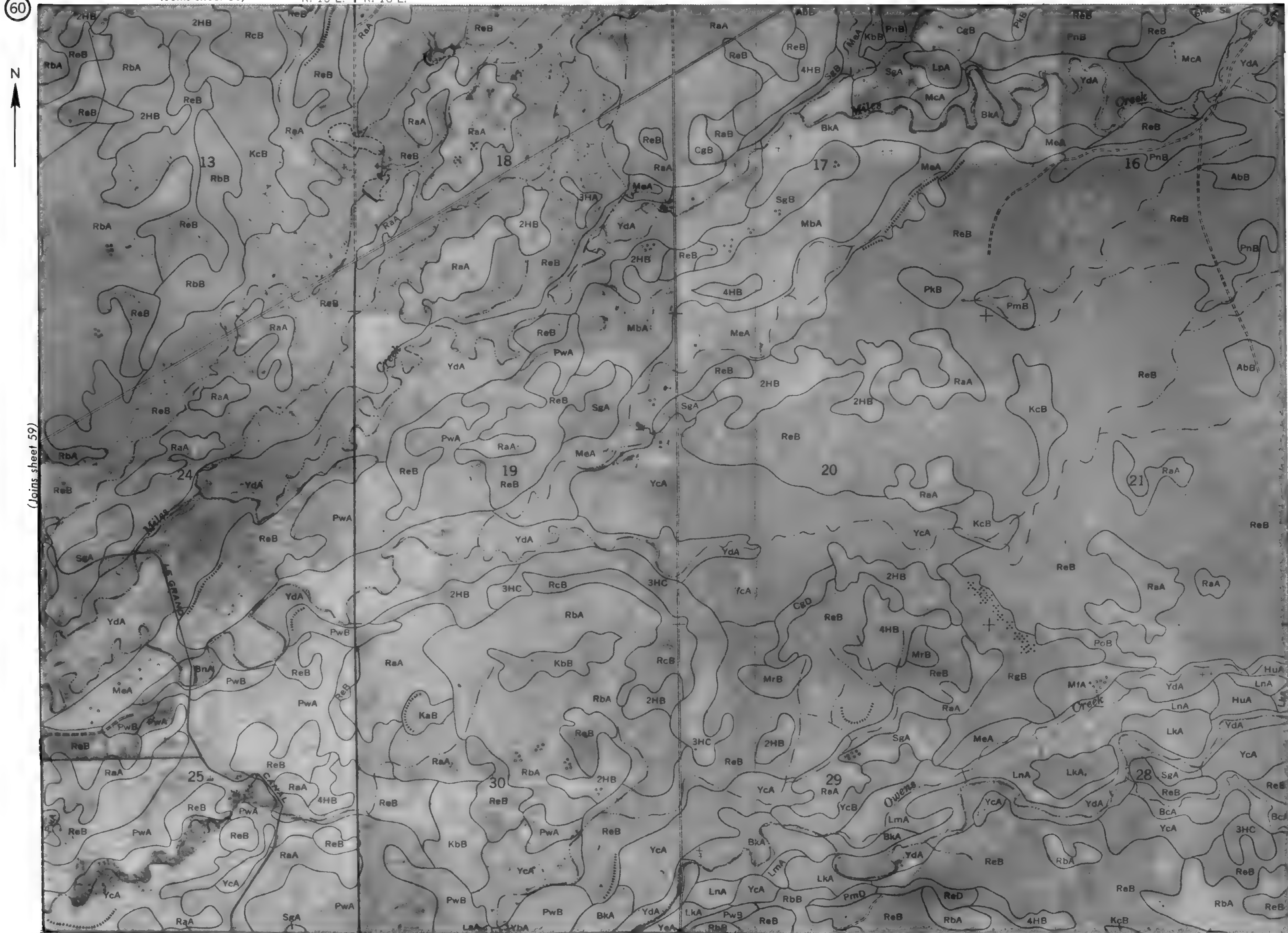
Range, township, and section corners shown on this map are indefinite.

60

(Joins sheet 50)

R. 15 E. | R. 16 E.

(Joins sheet 59)

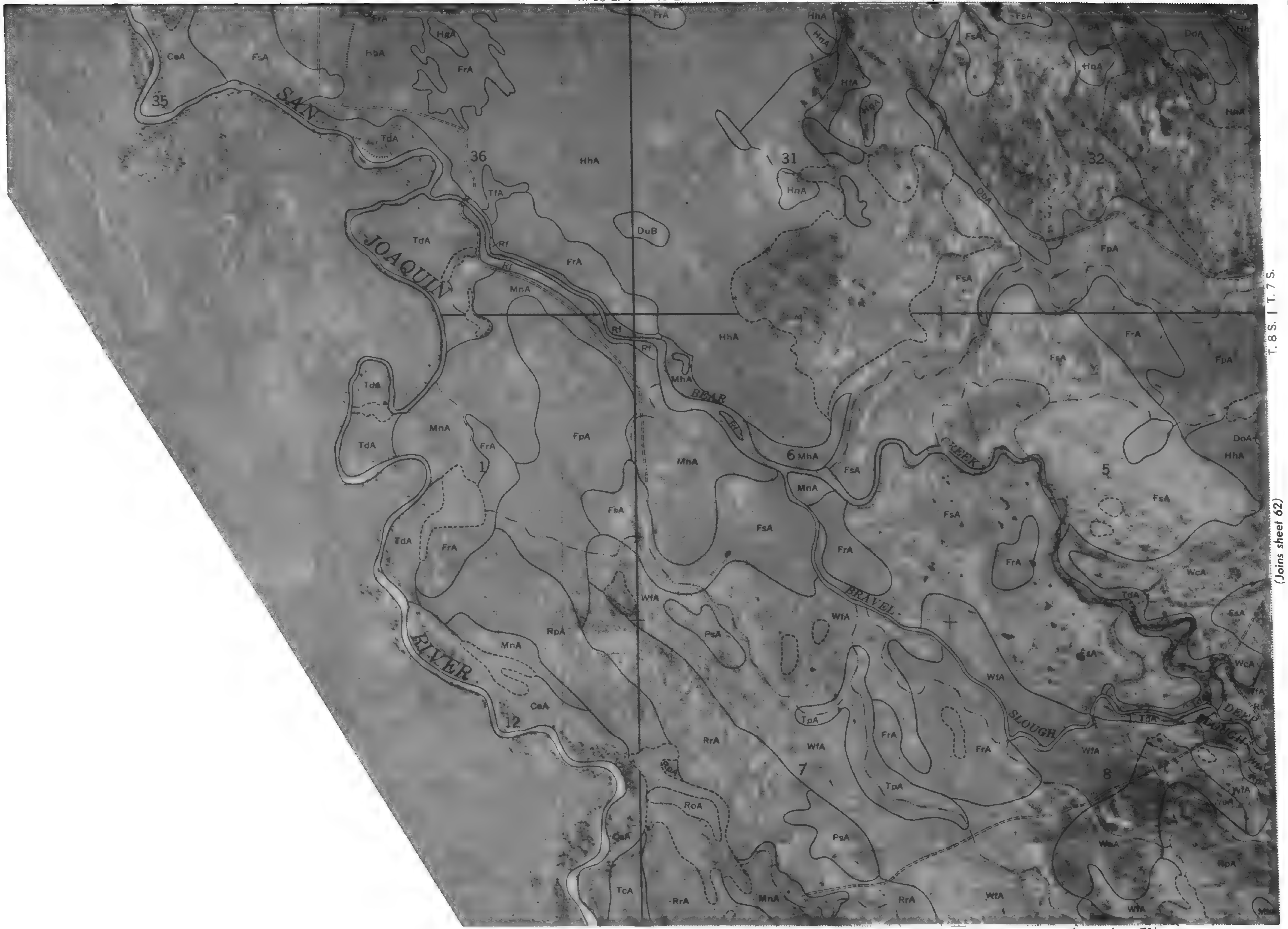


T. 7 S.

(Joins inset, sheet 70)

(Joins sheet 68) | (Joins sheet 69)

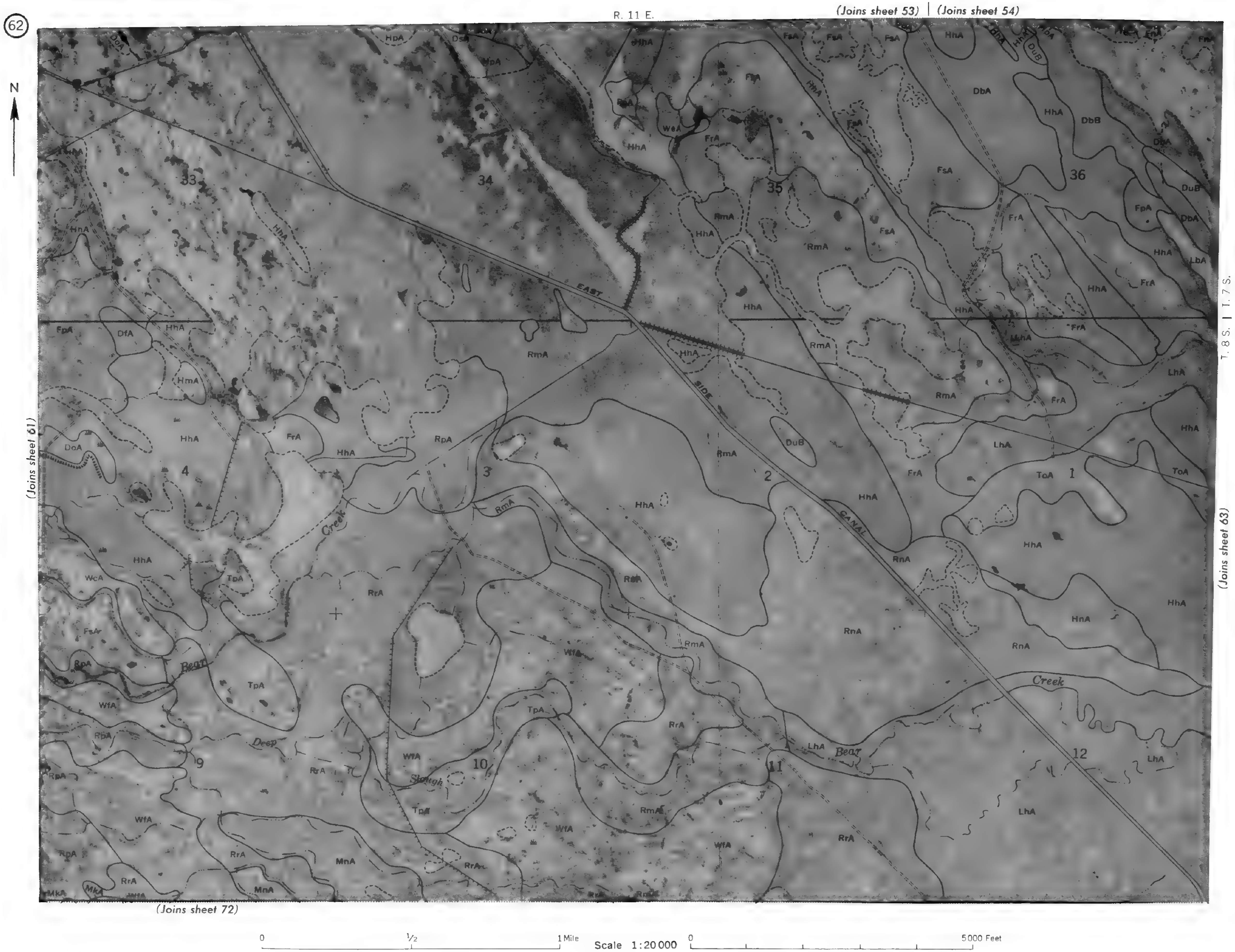
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

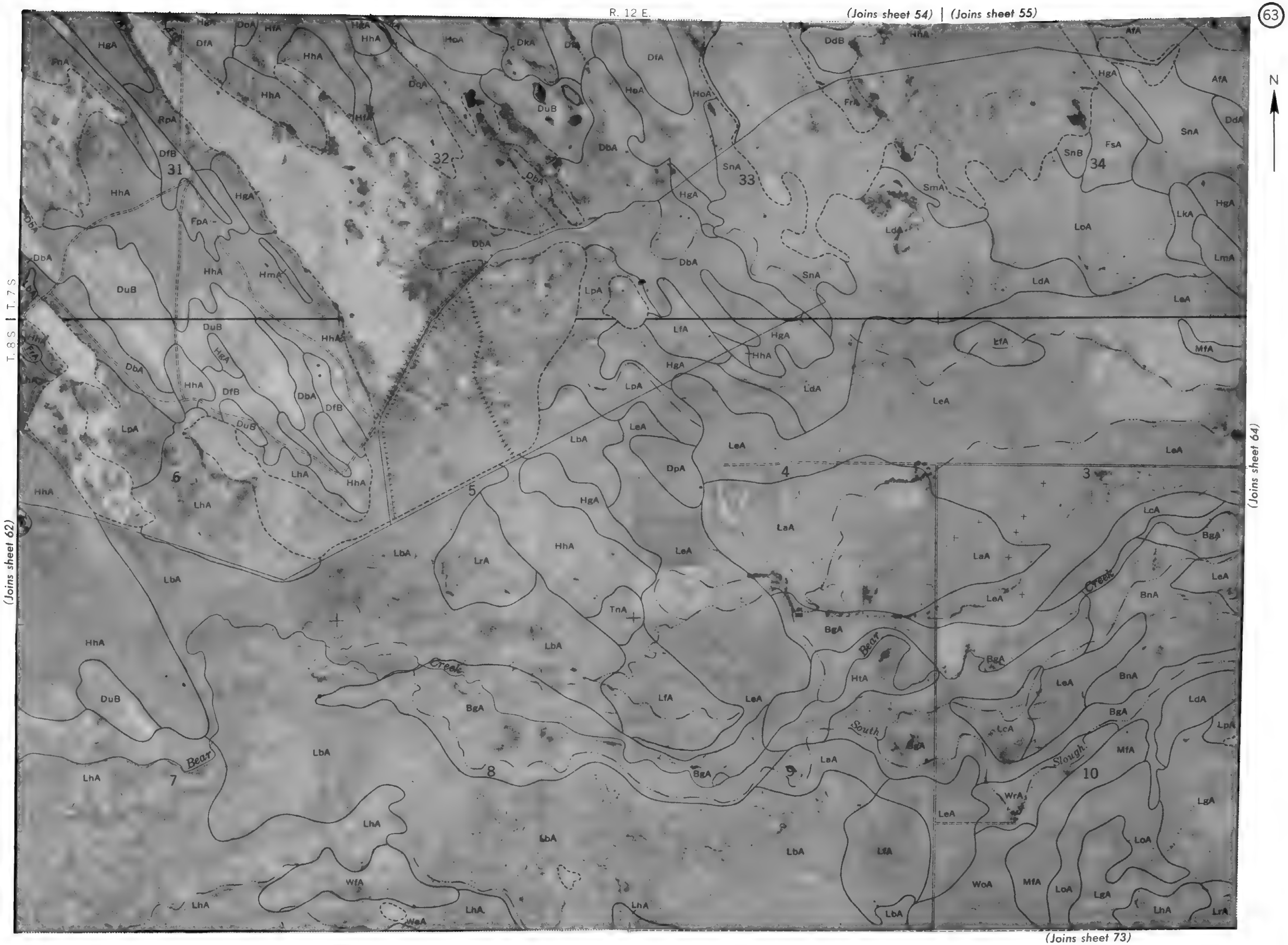
Range, township, and section corners shown on this map are indefinite.

0 — 1/2 — 1 Mile Scale 1:20 000 0 — 5000 Feet


62
R. 11 E.
(Joins sheet 53)
(Joins sheet 54)
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 72)
T. 7 S.
T. 8 S.
N
EAST SIDE CANAL
Bear Creek
Deep Slough
Creek
33
34
35
36
4
3
2
1
9
10
11
12
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 64

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 65

R. 13 E.

(Joins sheet 56) | *(Joins sheet 57)*

65

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

T. 7 S. | T. 8 S.

(Joins sheet 64)

(Joins sheet 66)

(Joins sheet 75)

N

0 | 1/2 | 1 Mile | Scale 1:20000 | 0 | 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 66

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 67

(Joins sheet 58) | (Joins sheet 59)

67

(Joins sheet 66)

(Joins sheet 68)

R 14 E. | R. 15 E.

(Joins sheet 77)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

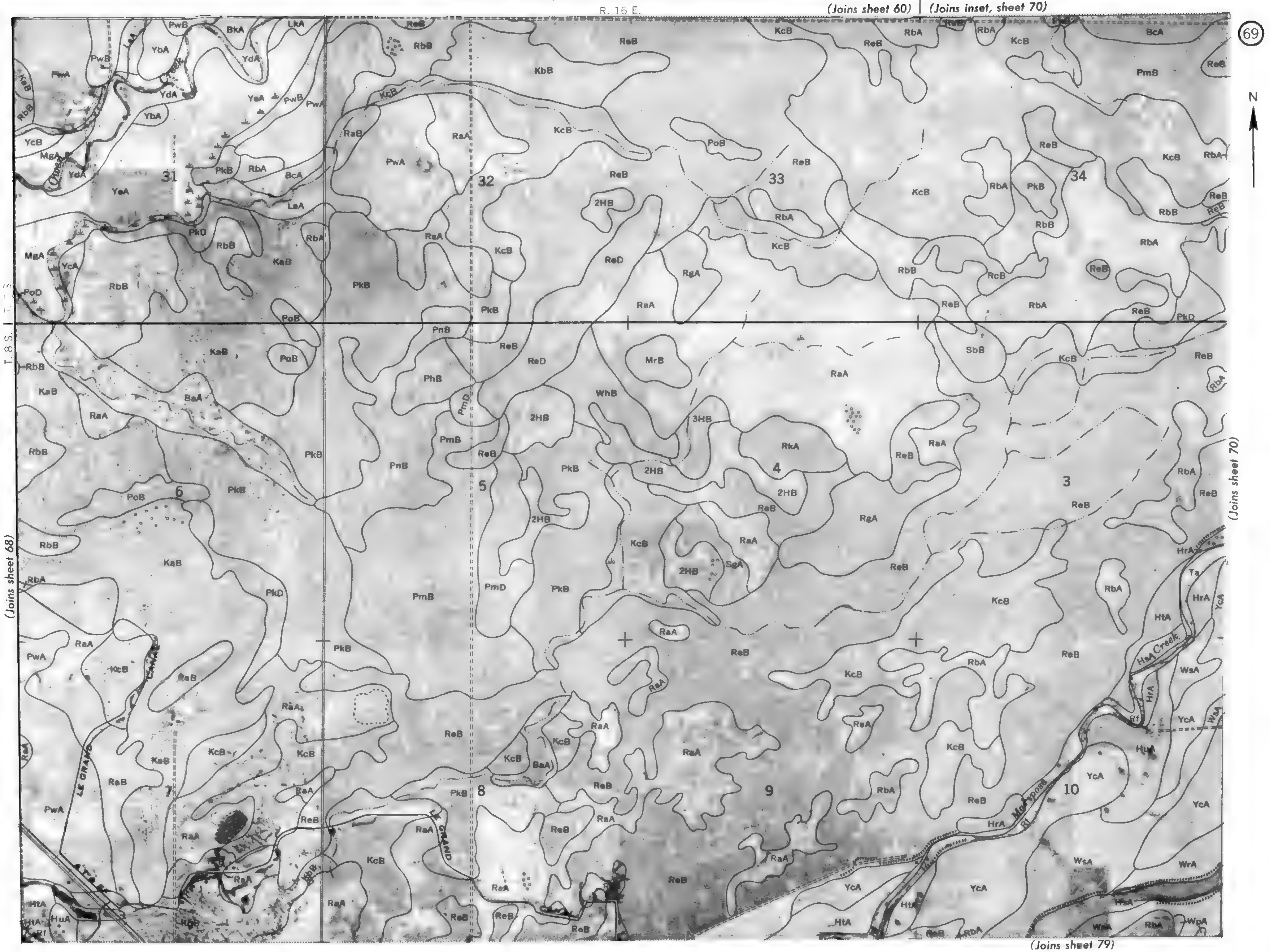
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 68

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 69



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

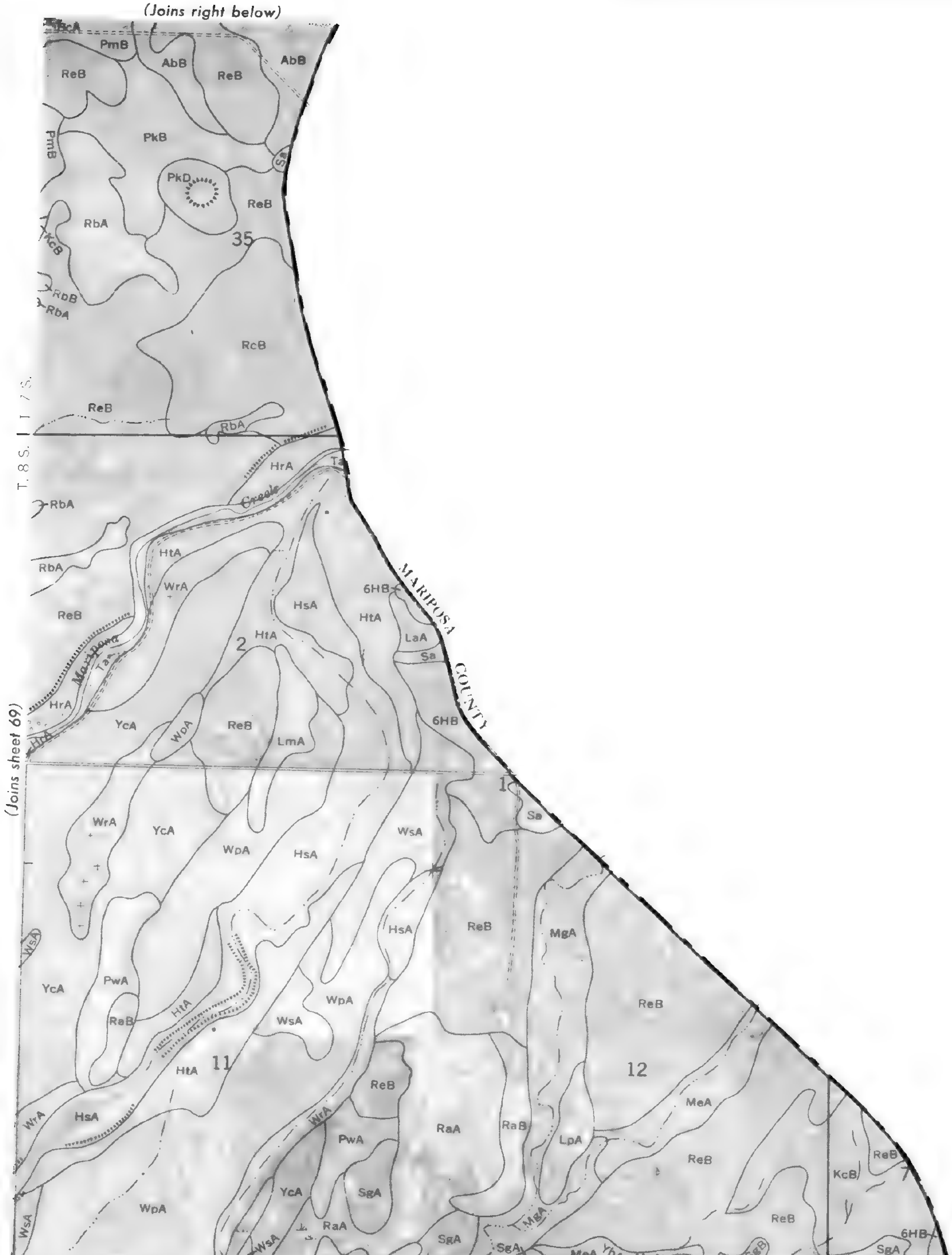
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950

Range, township, and section corners shown on this map are indefinite.

70

N

(Joins right below)



(Joins sheet 50)

Scale 1:20 000

0 1/2 1 Mile

0 5000 Feet

71

R. 10 E. | R. 11 E.

(Joins sheet 61)

N

T. 8 S.

(Joins sheet 72)

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 72

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

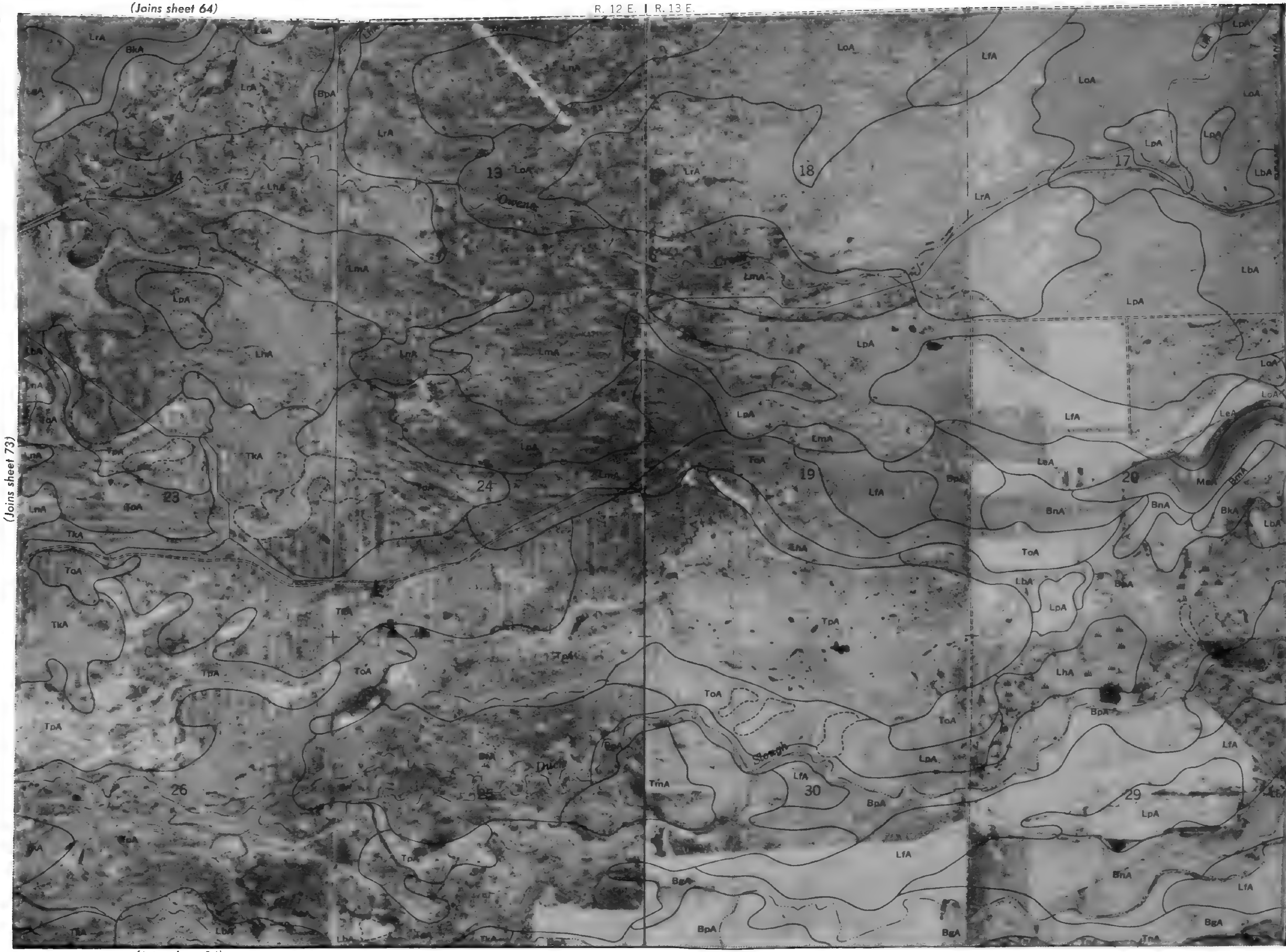
Range, township, and section corners shown on this map are indefinite.

MERCED AREA, CALIFORNIA - SHEET NUMBER 74

74

N

(Joins sheet 64)



(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 84)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

R. 13 E.

(Joins sheet 65)

(75)

N

(Joins sheet 74)

(Joins sheet 76)

(Joins sheet 85)

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs taken in [illegible]

Range, township, and section corners shown on this map are indefinite.

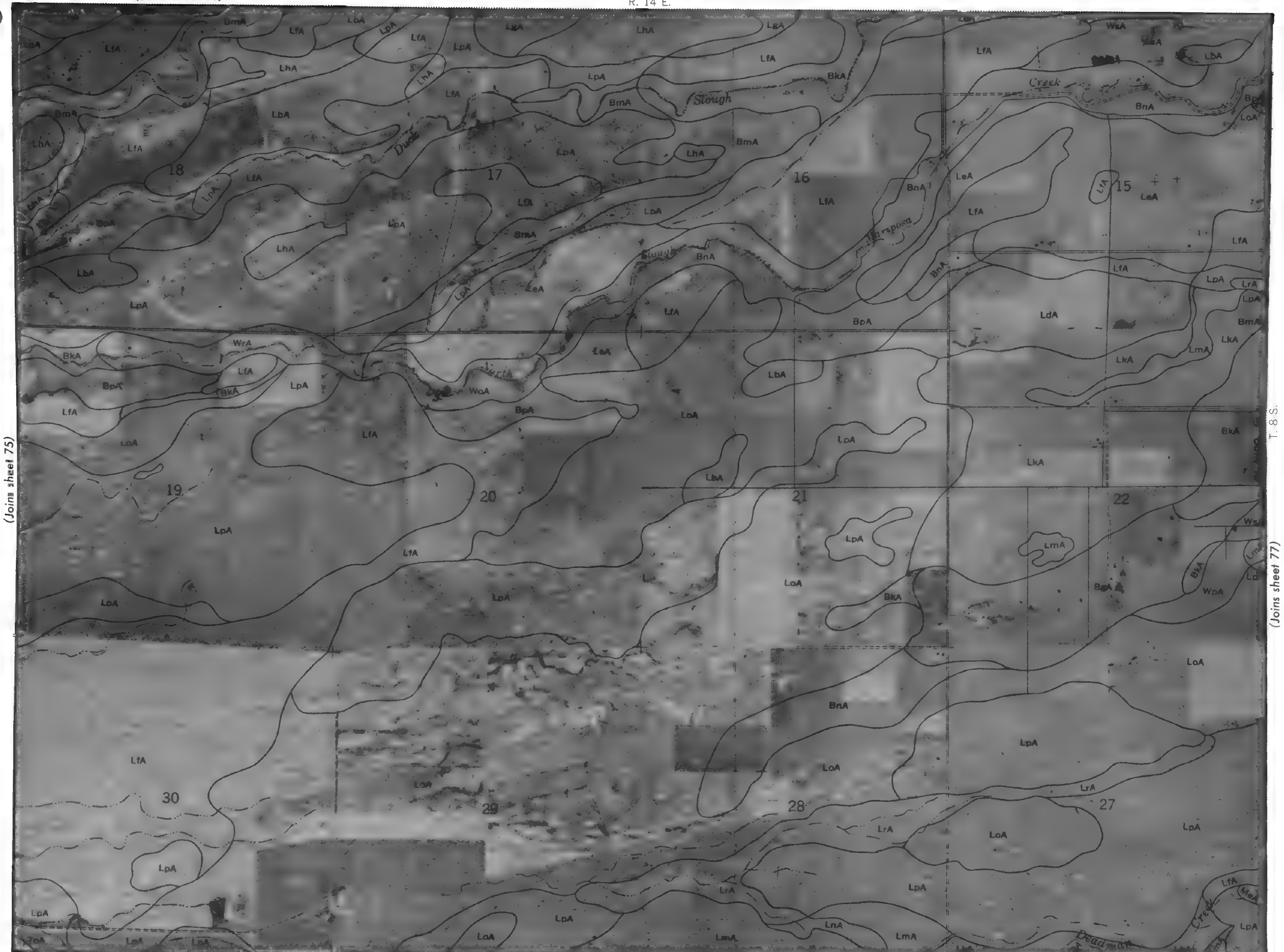
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(76)

(Joins sheet 66)

R. 14 E.

N



(Joins sheet 75)

T. 8 S.

(Joins sheet 77)

(Joins sheet 86)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(77)

R. 14 E. | R. 15 E.

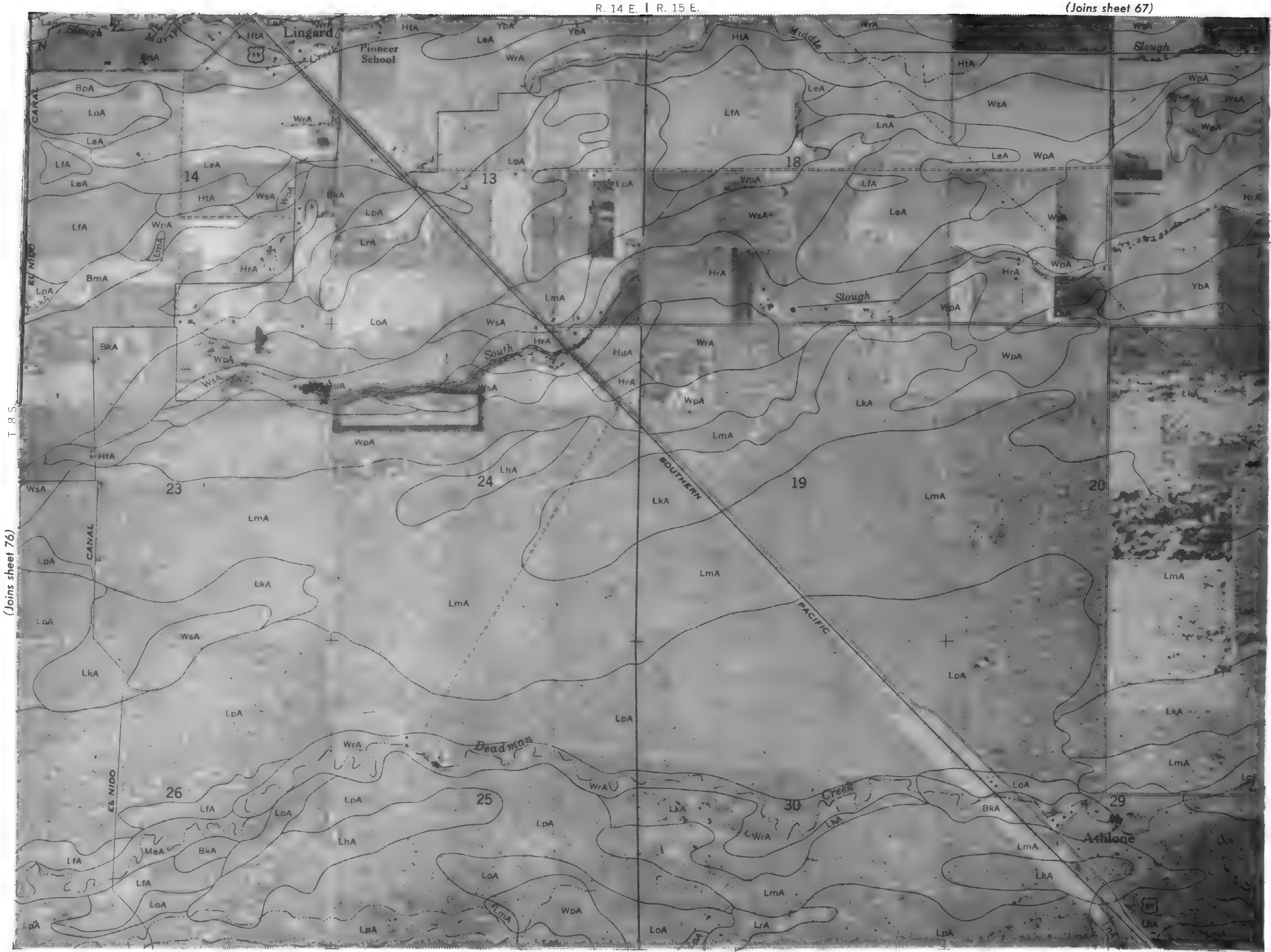
(Joins sheet 67)

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

T. 8 S.

(Joins sheet 76)

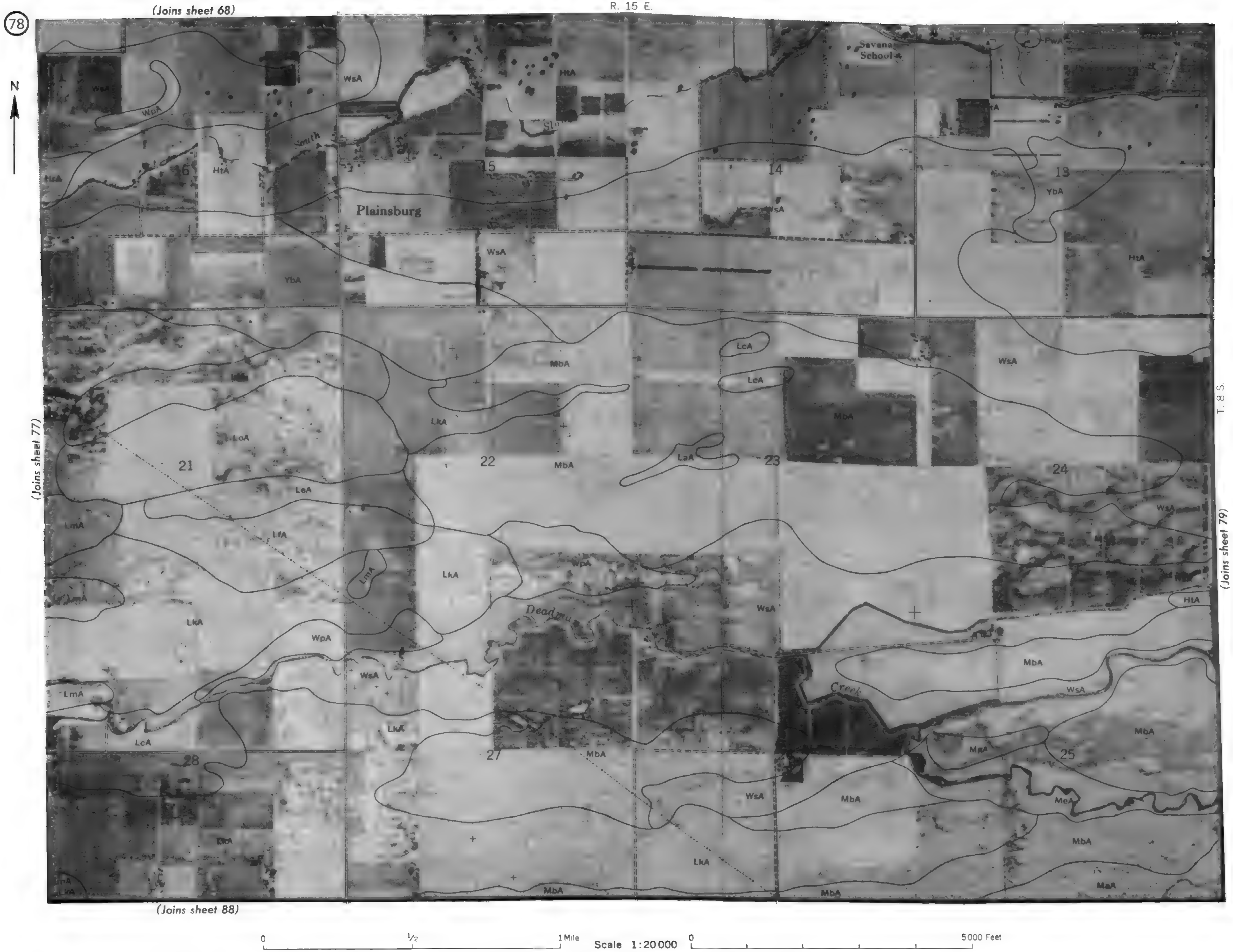


(Joins sheet 78)

(Joins sheet 87)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 78



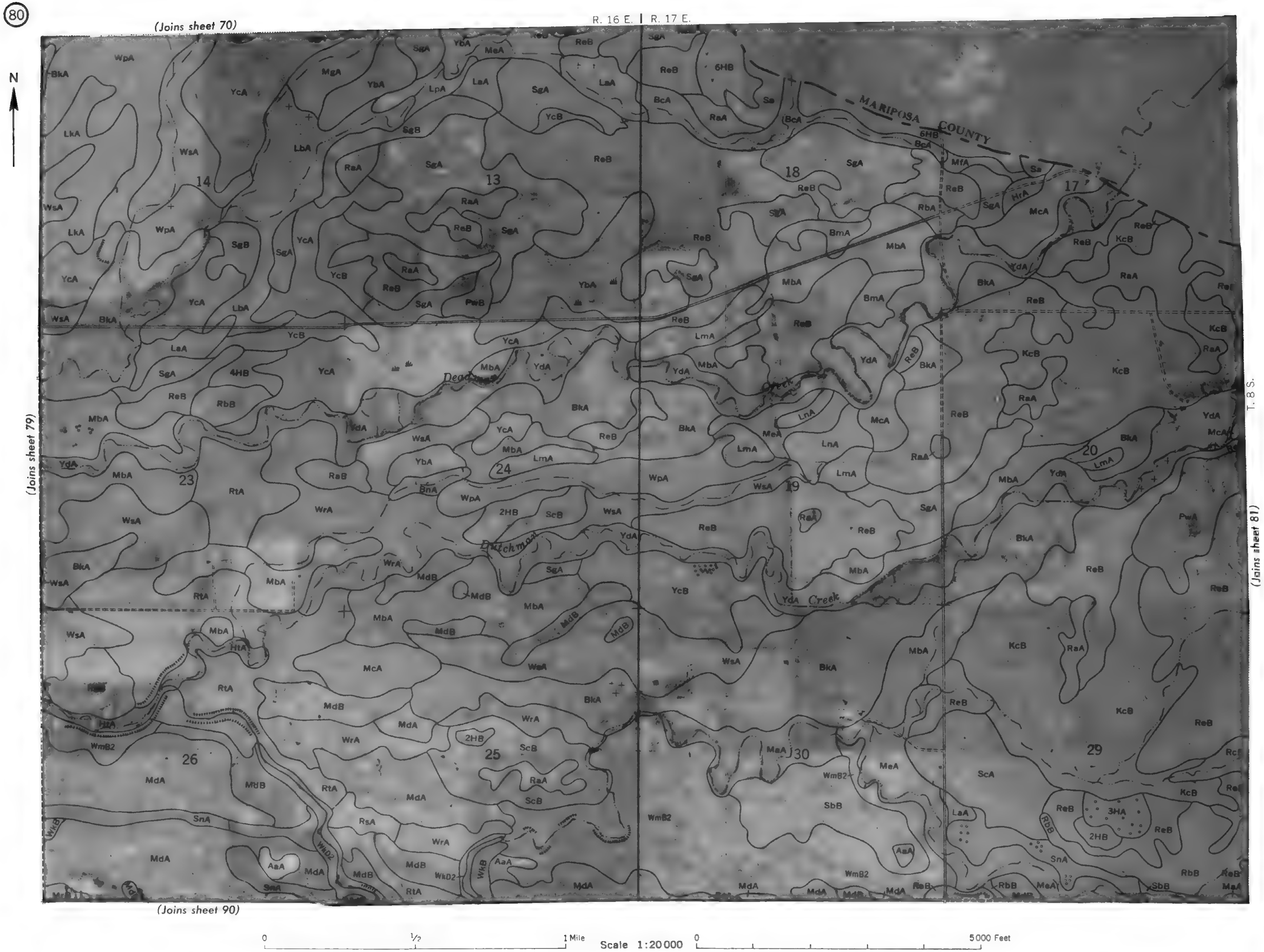
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. or information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 80

80



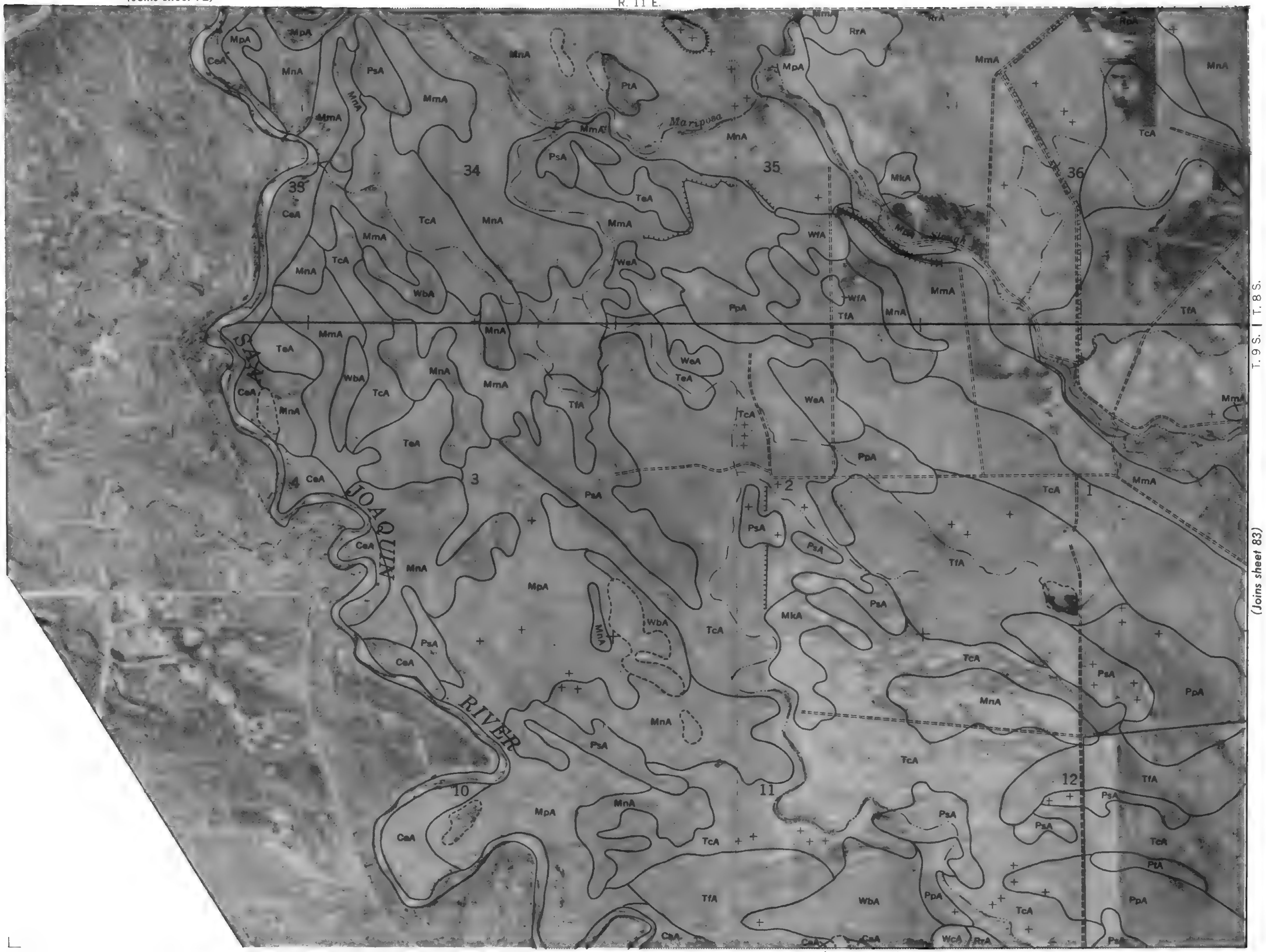
MERCED AREA, CALIFORNIA - SHEET NUMBER 81

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

82

(Joins sheet 72)



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

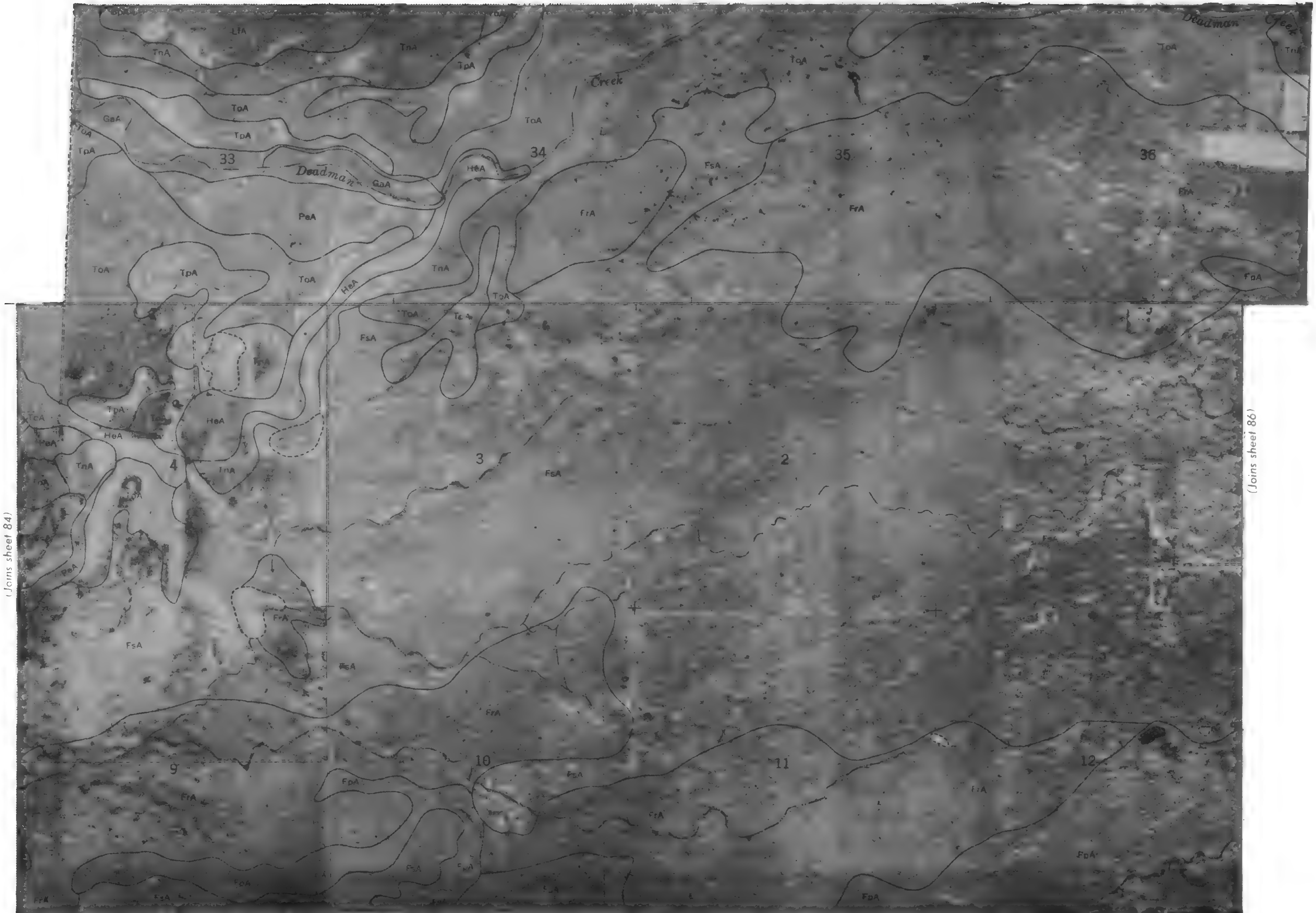
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 1/2 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 75)

85



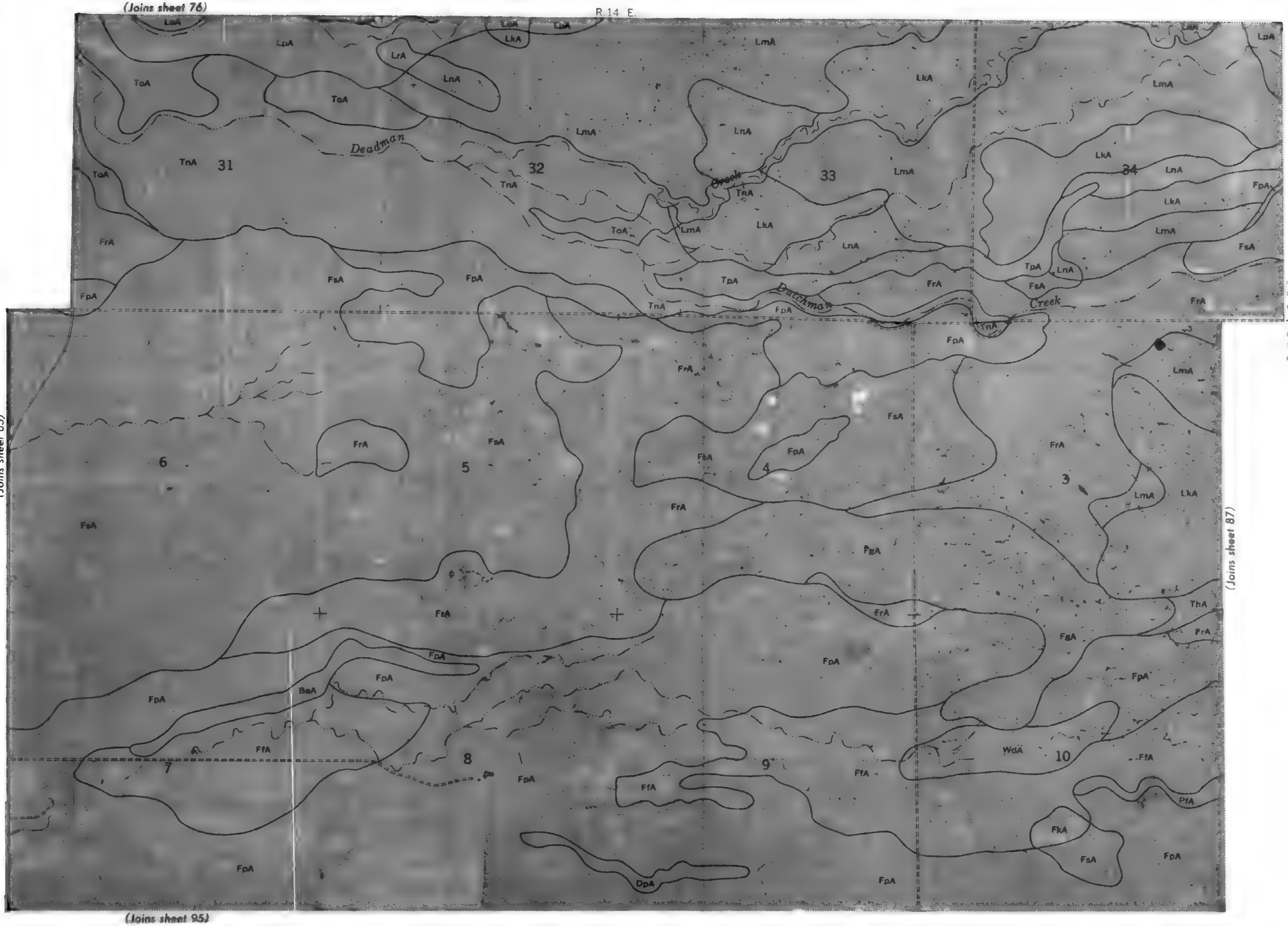
(Joins sheet 94)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

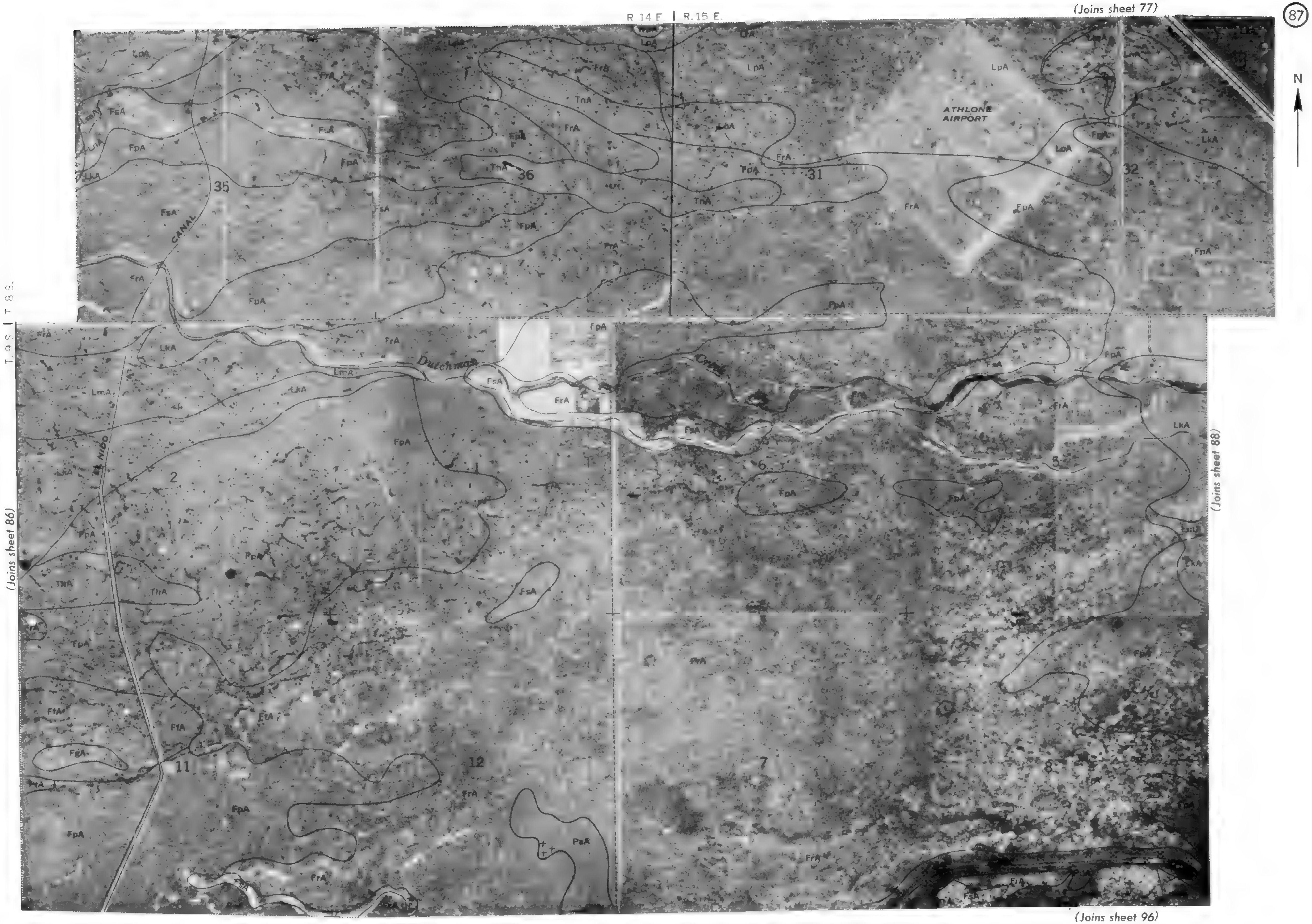
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

86



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

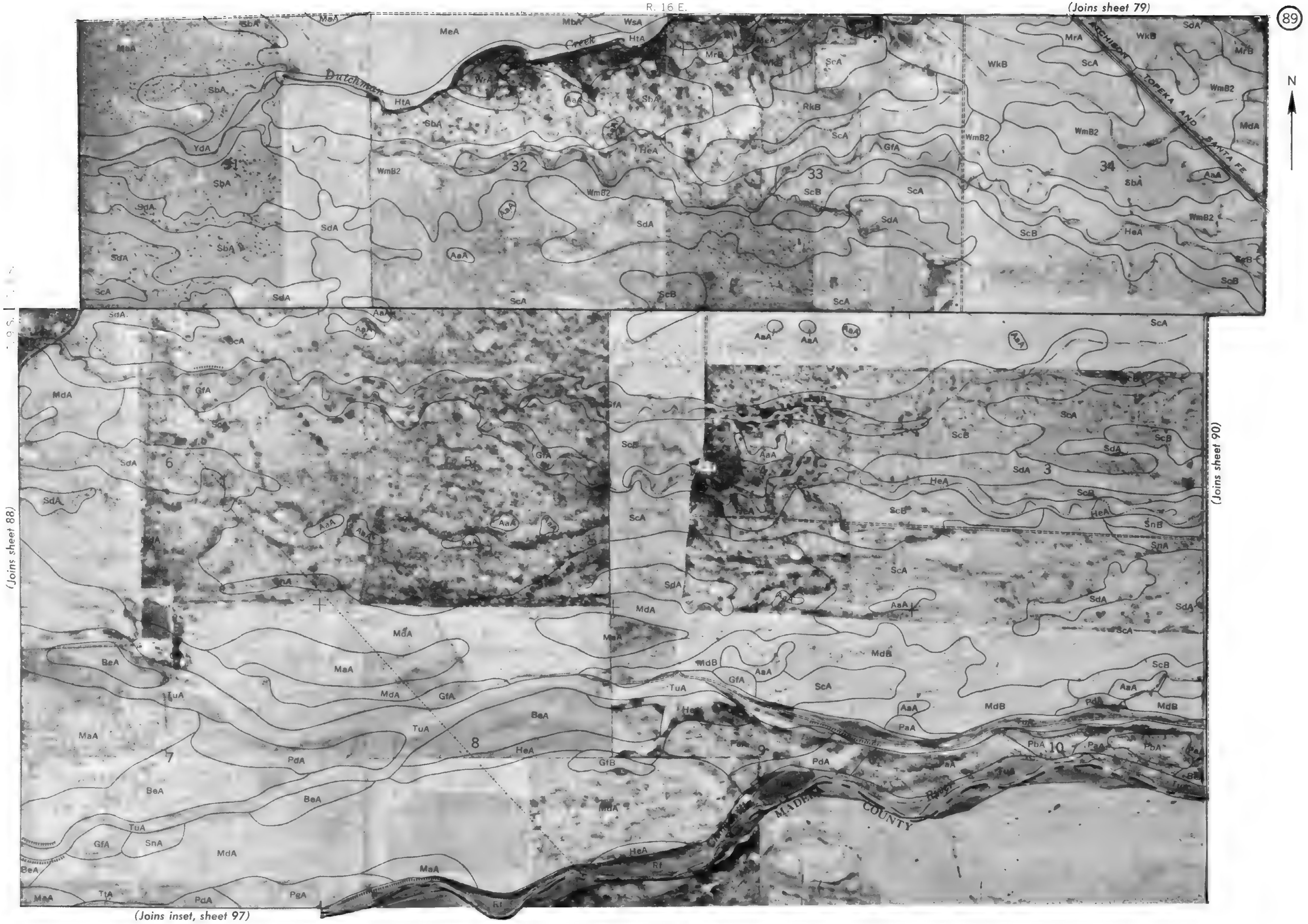


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

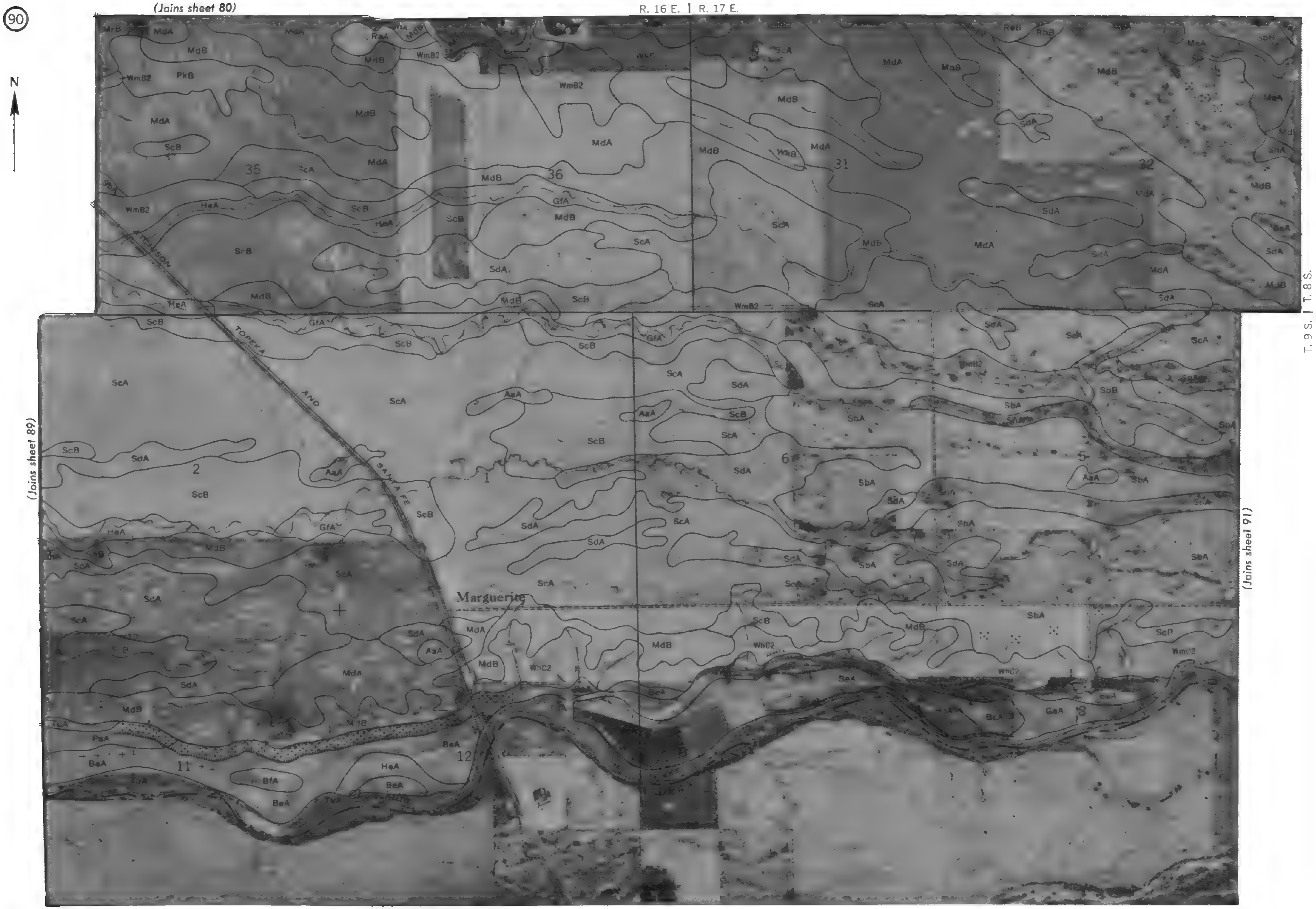
Scale 1:20 000
0 ½ 1 Mile
0 5000 Feet



Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

90



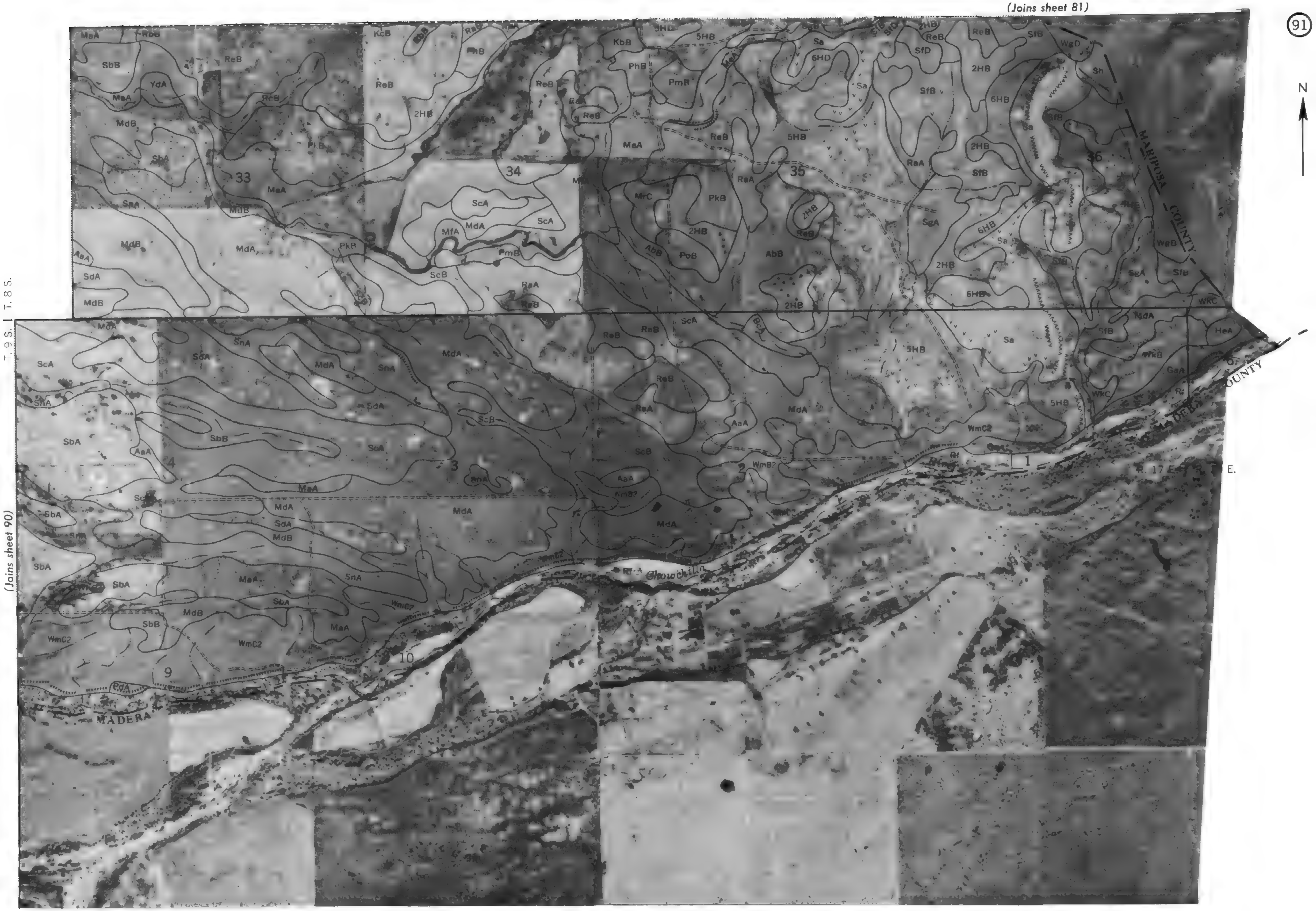
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 81)

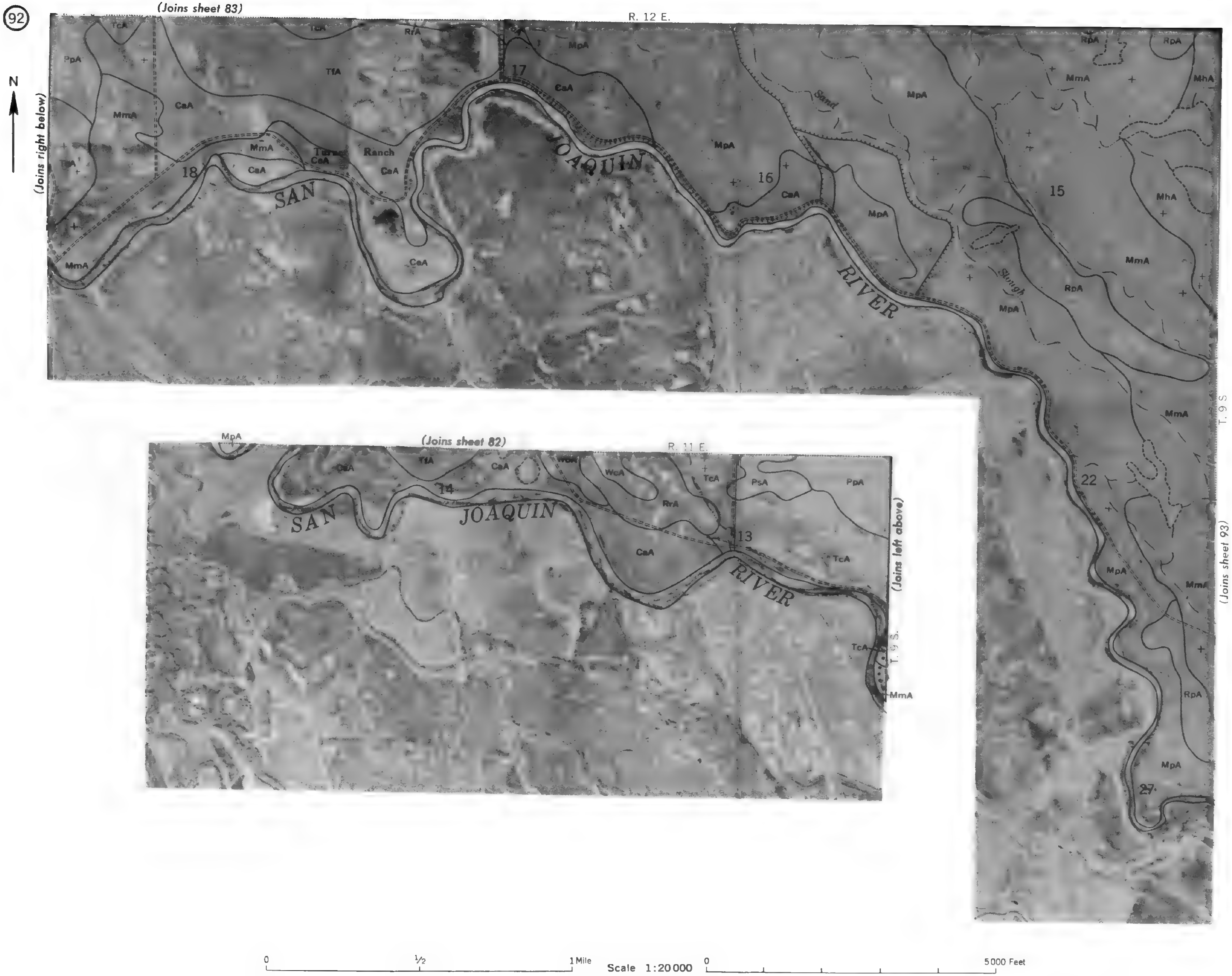
91

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 19[illegible]

Range, township, and section corners shown on this map are indefinite.



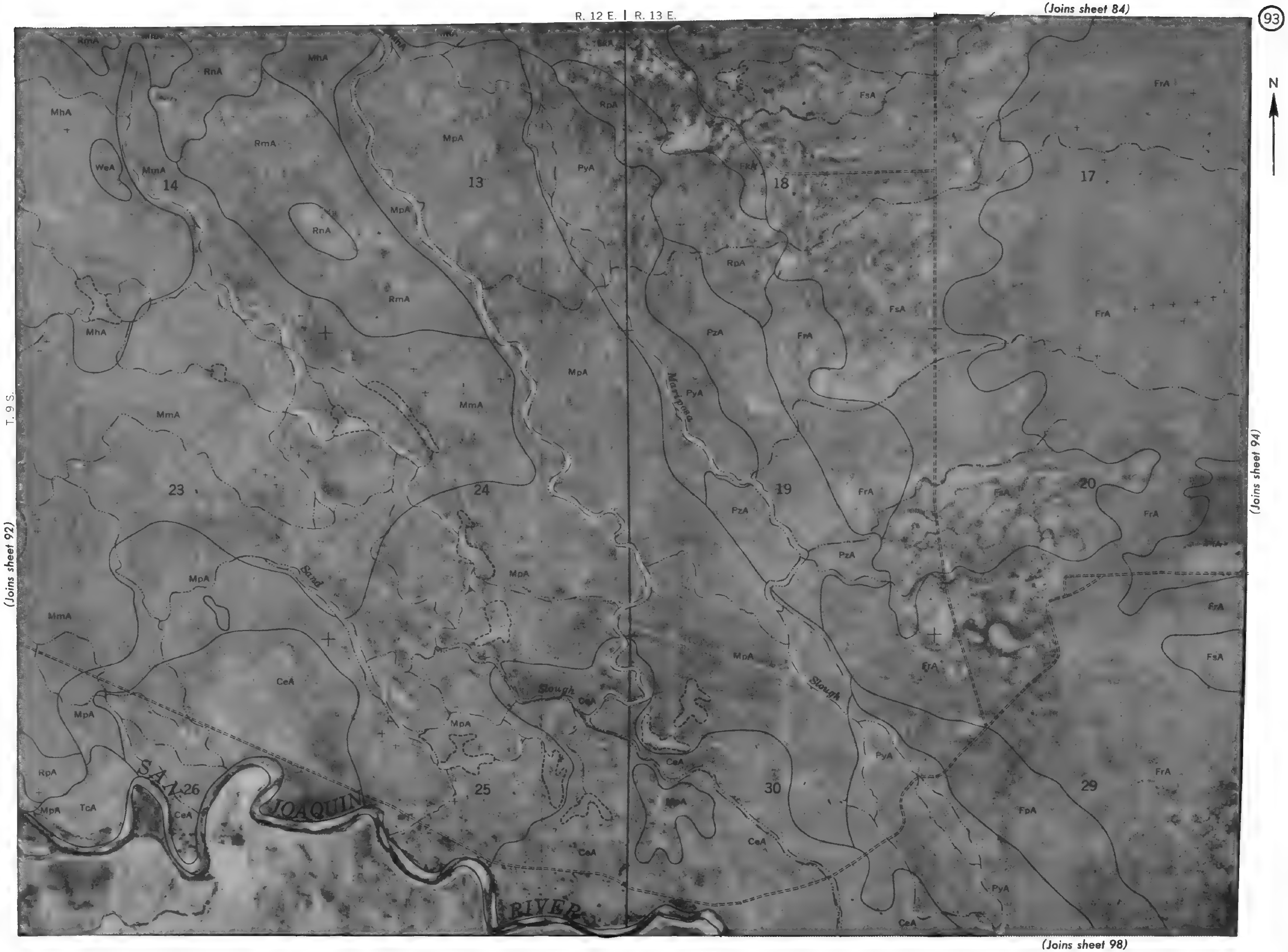
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


92
(Joins sheet 83)
R. 12 E.
N
(Joins right below)
PpA
TcA
RrA
MpA
TtA
17
CaA
MmA
Sand
MpA
MmA
RpA
RpA
MhA
MmA
Turner
Ranch
CaA
CaA
18
SAN
JOAQUIN
MpA
16
CaA
15
MhA
MpA
MmA
CeA
RIVER
Slough
RpA
MpA
MmA
T. 9 S.
(Joins sheet 82)
MpA
R. 11 E.
TtA
CaA
WoA
TcA
PsA
PpA
14
RrA
SAN
JOAQUIN
CaA
13
(Joins left above)
TcA
RIVER
22
MpA
MmA
(Joins sheet 93)
TcA
T. 9 S.
MmA
RpA
MpA
27
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 93

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20000 0 5000 Feet

94

(Joins sheet 85)

R. 13 E.

(Joins sheet 93)

T. 9 S.

(Joins sheet 95)

(Joins sheet 99)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

R. 14 E.

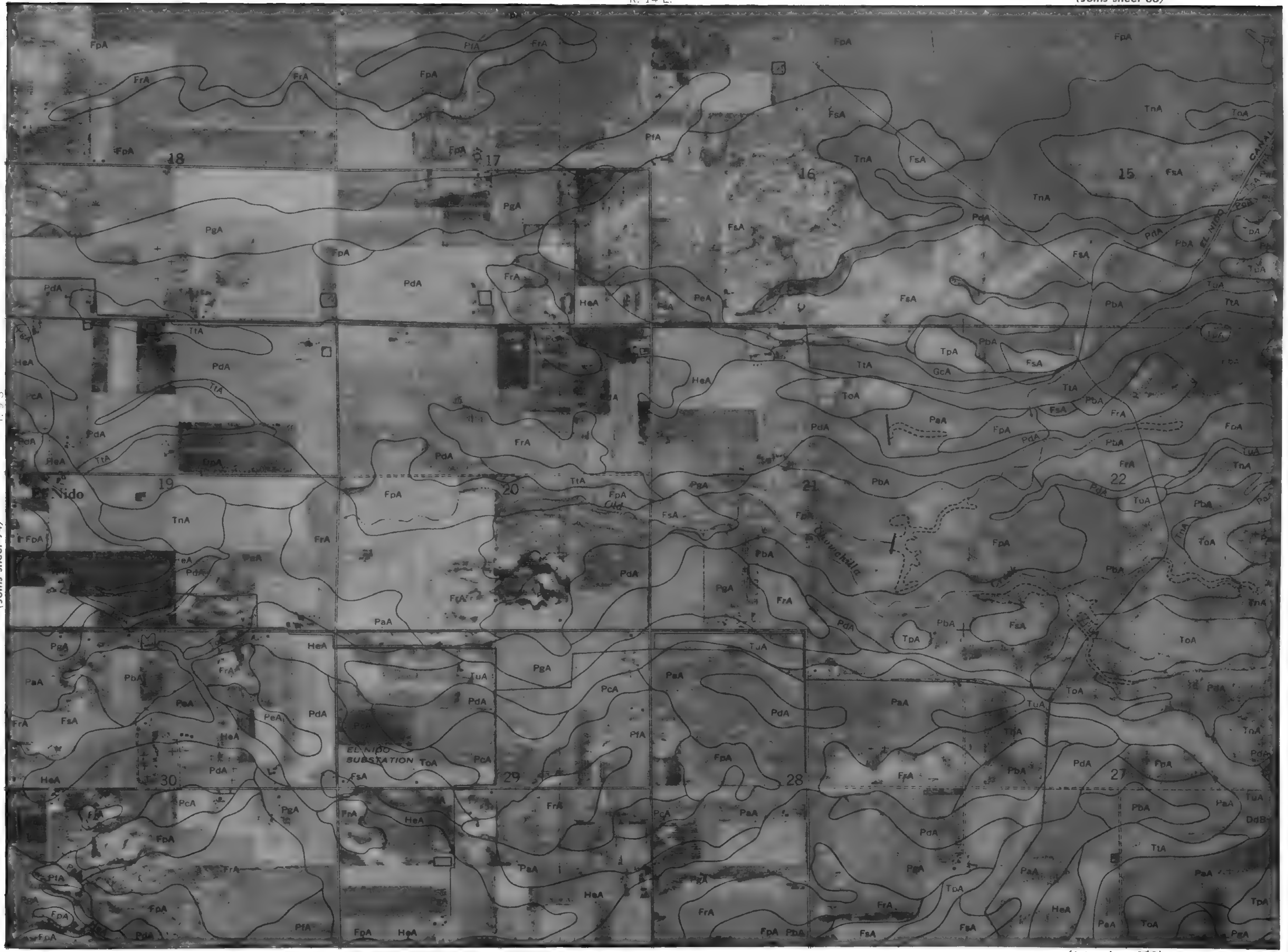
(Joins sheet 86)

95

N

T. 9 S.

(Joins sheet 94)



(Joins sheet 96)

(Joins sheet 100)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

96

(Joins sheet 87)

R. 14 E. | R. 15 E.

N

(Joins sheet 95)

(Joins sheet 97)

T. 9 S.

(Joins inset, sheet 100)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

98

N

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

MERCED AREA, CALIFORNIA - SHEET NUMBER 99

R. 13 E.

(Joins sheet 94)

99

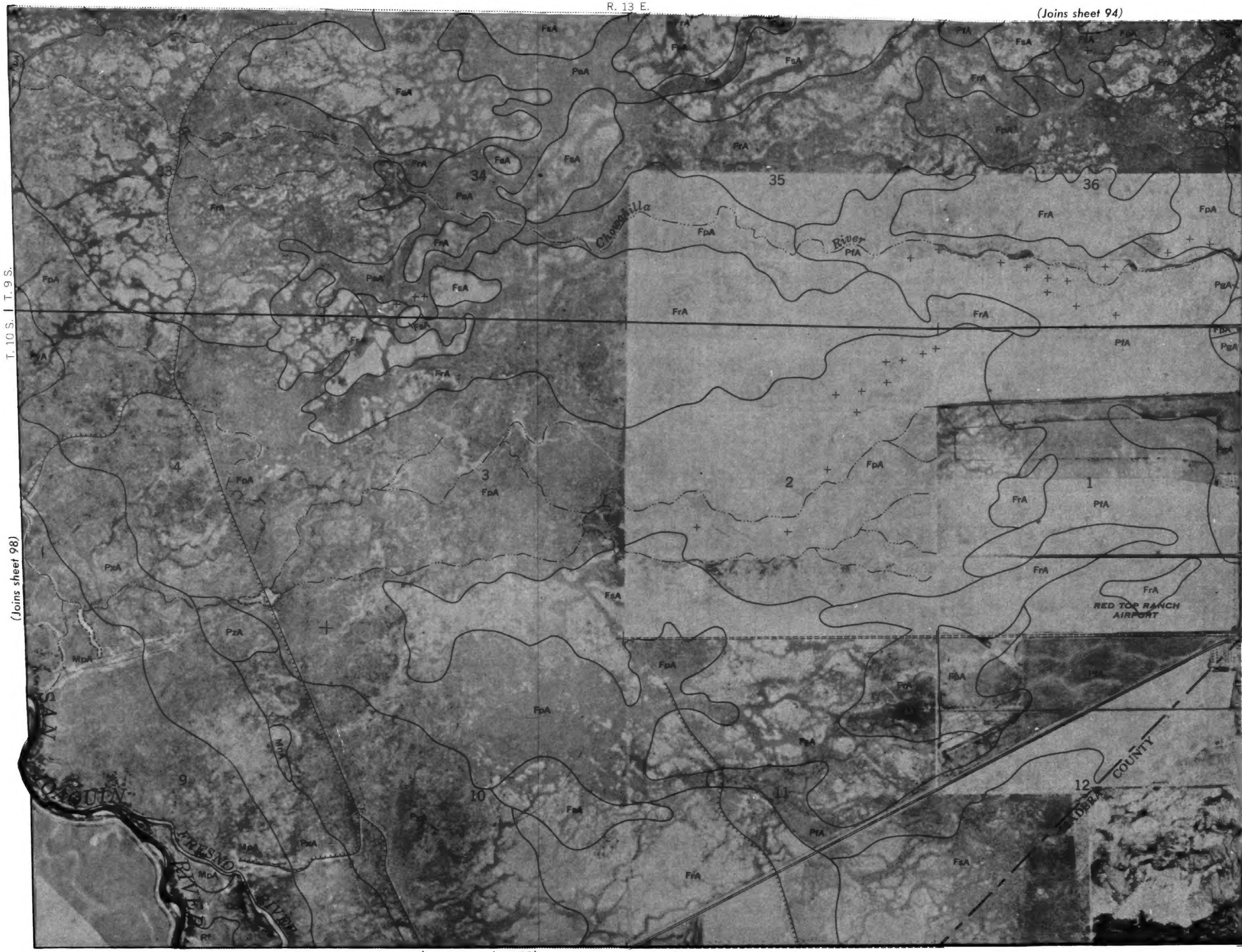
N

T. 9 S.

T. 10 S.

(Joins sheet 98)

(Joins sheet 100)



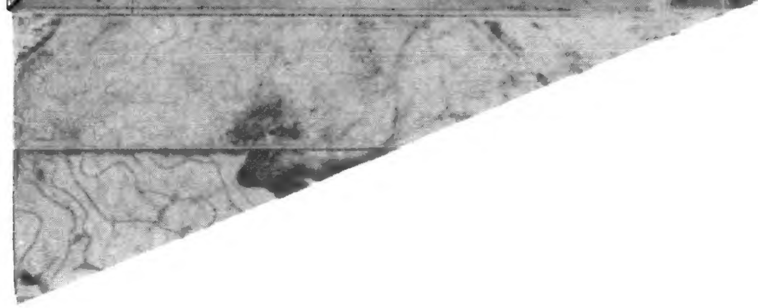
(Joins inset, sheet 98)

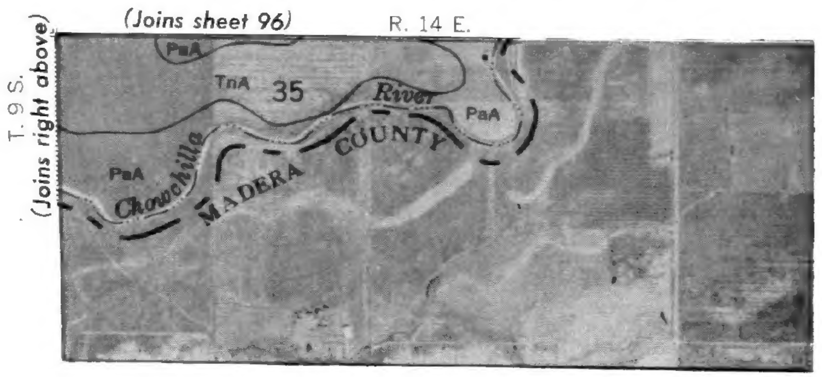
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1950.

Range, township, and section corners shown on this map are indefinite.

100





0 ½ 1 Mile Scale 1:20000 0 5000 Feet